Vol. VII.—No. 35.] [DECEMBER, 1887.

THE

MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

Mineralogical Society.

INSTITUTED 3rd FEBRUARY, 1876.

EDITED BY A COMMITTEE OF COUNCIL.

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THE MINERALOGICAL SOCIETY

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No. 35. DECEMBER 1887. Vol. VII.

On a Meteoric Iron seen to fall in the District of Nejed, Central Arabia, in the year 1863.

By L. Fletcher, M.A., F.C.S., President; Keeper of Minerals, British Museum; late Fellow of University College, Oxford.

[Read May 10th, 1887.]

IN 1885 a trustworthy Persian agent, through whom various antique objects had been already acquired for the British Museum, offered for sale to its authorities a so-called thunderbolt, weighing 131 lbs. (59·4 kilograms), and submitted at the same time the following translation of a Persian letter from his Excellency Hajee Ahmed Khane Sarteep, Ex-Governor-General of Bunder Abbas, Persian Gulf, and Grand Vizier of Muscat:—

"Bushire, dated 14th Di Koodah, 1301.

"Received on the 7th October, 1884.

"In the year 1282 after the death of Mahomed, when Mame Faisale Ben Saoode was Governor and General-Commander-in-Chief of the Pilgrims, residing in a valley called Yakki, which is situated in Nagede, in Central Arabia, Schiekh Kalaph Ben Essah, who then resided in the above-named valley, came to Bushire, Persian Gulf, and brought a large thunderbolt with him for me, and gave me the undermentioned particulars concerning it.

"'In the spring of the year 1280, in the valley called Wadee Banee Khaled, in Nagede, Central Arabia, there occurred a great storm, thunder and lightning being particularly prevalent; and during the storm an enormous thunderbolt fell from the heavens, accompanied by a dazzling light, similar to a large shooting star, and it embedded itself deeply into the earth. During its fall the noise of its descent was terrific. I, Schiekh Kalaph Ben Essah, procured possession of it, and brought it to you, it being the largest that ever fell in the district of Nagede. These thunderbolts, as a rule, only weigh two or three pounds, and fall from time to time during tropical storms.'

"The above concludes the narrative of Schiekh Kalaph Ben Essah.

"I myself saw in Africa four years after the above date a similar one, weighing 133 pounds, to that which Schiekh Kalaph Ben Essah brought to me, and the Sultan of Zanzibar, Sayde Mayede, obtained possession of it and forwarded it to Europe for the purpose of having it converted into weapons. For this reason I have forwarded my thunderbolt to London (as when melted and made into weapons they were of the most superior kind and temper), considering it one of the wonders of the world, and may be a benefit to science.

"The said Schiekh Kalaph Ben Essah, who brought me this thunderbolt, is still alive, and under Turkish Government control at Hoodydah, near Jeddah.

"Yours truly,

"(Signed) Hajee Ahmed Khane Sarteep."

As the mass presents characters identical with those of undoubted meteoric irons, the genuineness of the account given in the above letter is almost beyond criticism: the *naive* remark that Nejed thunderbolts as a rule only weigh 2 or 3 lbs. should convince the most sceptical that intentional deceit is here out of the question.

The mass is thus one of the small group of meteoric irons, numbering at most nine or ten, of which the fall has been actually observed; and of these it is the largest.

The first day of the year 1280 of the Mahommedan Calendar corresponds to June 18th, 1863, of our reckoning.

The mass is rudely tetrahedral in shape: its length is 16 inches (41 cm.), and the breadth and thickness are both about 11 inches (28 cm.). The surface is completely covered with pittings, similar to those of the Braunau and Johnson County irons; such pittings are often shown by the meteoric stones. There is no evidence of weathering, and on the greater part of

the surface the thin black crust of magnetic oxide of iron formed during the passage through the air is visible.

Relative to water at 4°, and allowing for displaced air, the specific gravity at 23° C. of a thin slice weighing 6·0859 grams was determined to be 7·863 (uncorrected 7·89).

Relative to a solution of copper sulphate, the iron is active, the reducing action having visible results after two minutes from the beginning of contact.

The iron is soft, and is easily cut with a hack-saw. During the preparation of some thin slices, small enclosures both of graphitic carbon and of troilite were met with, and present the usual characters: no stony matter was apparent.

On the large polished face, in addition to some smaller enclosures of troilite, there is one having a breadth of 3 mm. and a length of 9 mm.: several cracks starting from it are filled with the same material.

When etched with bromine-water the polished surface displays excellently the Widmanstätten figures: the beams of kamacite are straight and long, and are sometimes uninterrupted for a distance of three or four centimeters: on a section so taken that the beams form approximately equilateral triangles, their thickness averages about 0·8 millimeters. In the groups of parallel beams of grey kamacite extremely thin layers of intervening bright tänite are visible. The remaining plessite, which is very similar to the kamacite in its appearance, shows the fine parallel ridges ("combs") mentioned by Reichenbach. Large patches of the etched face have an orientated sheen. The etched section is very similar to that of Verkhne Udinsk: the figures are as well-defined as those of Toluca, but the beams of kamacite are longer, more even in thickness, and form larger groups, while the plessite is less striking.

When treated with warm dilute hydrochloric acid a fragment of the iron containing no visible enclosures yielded a black insoluble residue consisting chiefly of amorphous graphitic carbon: the last parts to dissolve were small thin bright metallic plates, of which some at least were enclosed by the carbon. Iron, nickel, cobalt, and copper were the only metals found in the solution: from an as yet unfinished examination of a photograph of the spectrum of the electric arc between poles of this iron, Professor Lockyer infers the presence of traces of titanium, aluminium, manganese, barium and calcium.

On analysis of the filings obtained during the levelling of the large

section, the following numbers were obtained by the methods already described,[1] and give as the average composition of the mass :—

	Nejed.	*Trenton.*	*Toluca.*	*V. Udinsk.*
Iron	91·04	91·03	90·74	91·05
Nickel ...	7·40	7·20	7·78	8·52
Cobalt ...	0·66	0·53	0·72	
Copper ...	trace	trace	0·03	—
Phosphorus ...	0·10	0·14	0·24	trace
Sulphur ...	trace	—	0·03	trace
Insol. Residue	0·59	0·45	0·34	0·58
	99·79	99·35	99·88	100·15

The black residue insoluble in *aqua regia* consists chiefly of amorphous carbon ; when heated on platinum foil it begins to smoke, and afterwards takes fire, burning with a luminous flame : it contains a trace of chromite, which gives a green colour to a bead of microcosmic salt.

In chemical composition the Nejed iron is very similar to Trenton, as determined by Lawrence Smith,[2] to one of the masses from the Toluca Valley, as determined by Pugh,[3] and also to Verkhne Udinsk, as determined by Kotschubei.[4]

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[1] *Min. Mag.* 1887, Vol. VII. p. 124.
[2] *Amer. Jour. Sc.* 1869, Series 2, Vol. XLVII. p. 271.
[3] *Annal. der Chem. und Pharm*, 1856, Vol. XCVII. p. 385.
[4] *Zeitsch. d. deutsch. geol. Gesell.*, 1864, Vol. XVI. p. 356.

On a Meteoric Iron (containing Crystallised Chromite) found about the year 1880 in Greenbrier County, West Virginia, U.S.A.

By L. Fletcher, M.A., F.C.S., President; Keeper of Minerals, British Museum; late Fellow of University College, Oxford.

[Read October 25th, 1887.]

A SINGLE fragment of iron, having an estimated weight of eleven pounds, was found about the year 1880 on or near the top of Alleghany Mountain, 3 miles north of White Sulphur Springs, Greenbrier County, not far from the eastern border of West Virginia, U.S.A.; this corresponds to longitude 80° 20′ W. of Greenwich, latitude 37° 51′ N. The finder and his official agent, thinking it a piece of rich iron ore, searched unsuccessfully for a vein: the specimen itself was taken to a country smith's shop, heated and cut with a cold chisel; the pieces were distributed as specimens of iron ore. Some time afterwards, two of them, weighing respectively 63 oz. and 31 oz., were given by the agent to Mr. Matthew A. Miller, Civil Engineer, of Richmond, Virginia; convinced of their meteoric origin, he immediately tried to recover the pieces already distributed, but after travelling several hundred miles was forced to the conclusion that they were irrecoverably lost. From Mr. Miller the two pieces were acquired for the British Museum.

In shape they are irregular: each of them presents clear evidence of being fragmentary, the surface being partly smooth and pitted, and partly jagged, the latter showing in a remarkably distinct way edges, faces, and crevices which belong to an octahedral structure.

Relative to water at 4°, and allowing for displaced air, the specific gravity at 17°·2 C. of a thin slice, free from rust and weighing 11·0552 grams., was found to be 7·869 (uncorrected 7·89).

Relative to a solution of copper sulphate, a polished surface of the iron is immediately active.

The iron is extremely soft, and was easily sawn into slices.

On the polished faces of these no stony minerals are visible, but there are seen sections of a few rounded cavities, of which the contents have a greyish-black colour and a metallic lustre; this material is principally finely divided iron which has perhaps been worked into the cavities during the sawing of the specimen, and the subsequent levelling of the surface; the rest is graphitic carbon, which may have been sufficient to fill the cavities when the specimen was intact. No chromite was found in the cavities.

During the polishing of one of the sections a part of its surface was bent inwards, and there was found to be an empty cavity with plane faces: the quadrilateral lid of the cavity is 6 mm. long and 3 mm. wide: three of the edges of the section of the cavity were seen to be parallel to structural lines visible on the polished surface even before etching: the sides of the cavity were rusty. Similar cavities are shown by the iron from Rancho de la Pila, Durango, Mexico.

After treatment with bromine-water a polished face shows very distinct Widmanstätten figures. On a section not very much inclined to an octahedral face the beams of kamacite have a thickness varying from 0·8 to 1·2 mm.; they have straight edges, are in groups, and are sometimes uninterrupted for a length of 17 mm. They are separated by very thin layers of lustrous tänite. The remaining component, the plessite, is plentiful, but is very homogeneous in structure, and not very different in appearance from the kamacite. There is no orientated sheen, such as is presented by the etched surfaces of many meteoric irons. The figures approximate to those on one of the slabs of an iron from Staunton, Virginia, U.S.A., now shown in the British Museum: to this also it is very similar in its percentage composition, as pointed out later.

A fragment of the iron, presenting no visible enclosures, and weighing 1·6 grams., yielded a trace of sulphuretted hydrogen when warmed with dilute hydrochloric acid. Iron, nickel, cobalt and copper were found in the solution. The small black insoluble residue was evidently composite, for part of it was only slightly more dense than the solution, and remained for a time in a state of suspension, while the rest, after disturbance, quickly settled to the bottom of the flask. The former material was doubtless graphitic carbon; the latter, when washed and dried, was seen to consist of (1) a fine powder, (2) small fragments, (3) a thin elongated plate, and (4) a single opaque black crystal with bright faces and a metallic lustre.

The crystal was found to be very fragile, for it broke when pushed gently with a platinum wire. Some of the fragments of the crystal were faintly attracted by a bar magnet. The largest fragment was measured on the reflective goniometer, and found to present five of the faces of a regular octahedron: in addition, there are two narrow faces which give images; one of them is a face of the dodecahedron, and the other corresponds in position to a face of the form {221} : the angle (111·221) was measured to be 15°39′, the calculated angle being 15°48′. This fragment is a little more than a millimeter in diameter. Another fragment of the crystal was found to be insoluble in aqua regia, and imparted

a beautiful green colour to a bead of microcosmic salt. Another fragment was found to be incombustible and infusible. Hence we may infer that the crystal is doubtless chromite.

Microscopic crystals of this mineral occur in the meteoric stones, and minute crystals were found by Maskelyne[1] in the siderolite of Breitenbach; in the meteoric irons, however, the existence of crystallised chromite has up to the present not been completely established. The only instance appears to be one recorded by Shepard:[2] in the insoluble residue of the iron of Seneca River, Shepard found two octahedral crystals, weighing together $\frac{1}{200}$th of a grain, and presenting the octahedral form and the lustre of chromite: in the absence of further crystals no examination for chromium was made.

The fragility of this crystal of chromite is of some interest, as showing clearly that easy frangibility of a crystallised material, generally difficult to break, is in itself no proof of pseudomorphism: it will be remembered that the crystals of graphitic carbon obtained from the Youndegin iron possessed this character. Maskelyne has likewise directed attention to the fact that some of the rounded crystals of asmanite enclosed in the siderolite of Breitenbach are extraordinarily brittle on their surfaces, and often fly into fragments even with the most careful handling.

The fine powder, small fragments, and the thin elongated plate, were likewise found to be essentially chromite.

Phosphorus was found in the insoluble residue, and was present probably as phosphide of iron and nickel.

For the quantitative analysis 5·0789 grams. of the filings obtained from a large section of the iron were dissolved in aqua regia, and the following percentage composition was obtained by methods detailed in a previous paper:[3]—

	Greenbrier Co.	*Trenton.* (L. Smith.)	*Rio Juncal.* (Damour.)	*Seneca River.* (Shepard.)	*Staunton.* (Santos.)
Iron	91·59	91·03	92·03	92·12	91·44
Nickel	7·11	7·20	7·00 } 0·62 }	7·54	7·56
Cobalt	0·60	0·53			0·61
Copper	trace	trace			0·02
Phosphorus ...	0·08	0·14	0·21	0·08	0·07
Sulphur	trace				0·02
Residue	0·12	0·45		0·26	0·14
	99·50	99·35	99·86	100·00	99·86

[1] *Philosophical Transactions*, 1871, Vol. CLXI. p. 359.
[2] Amer. Jour. Sc. 1853, Ser. 2, Vol. XV. p. 365.
[3] *Mineralogical Magazine*, 1887, Vol. VII. p. 124.

In another experiment made to determine the copper and sulphur, 9·4364 grams. of the filings were treated with dilute hydrochloric acid, and the evolved gas was passed through bromine-water to which some hydrochloric acid had been added: the sulphur was found to be only 0·007 per cent. and the copper 0·01.

The above percentage composition is approximately that of the Trenton,[1] Rio Juncal,[2] Seneca River, and Staunton[3] irons, as shown in the adjacent columns.

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[1] *Amer. Journ. Sc.*, 1869, Ser. II. Vol. XLVII. p. 271.
[2] *Comptes Rendus*, 1868, Vol. LXVI. p. 569.
[3] *Amer. Journ. Sc.* 1878, Ser. III. Vol. XV. p. 337.

On Crystals of Cuprite and Cerussite resulting from the slow alteration of buried coins.[1]

By L. Fletcher, M.A., F.C.S., President.

THE coins referred to in this paper were received through Professor J. W. Judd, F.R.S., to whom they had been sent by Mr. George W. Shrubsole, F.G.S., Honorary Curator of the Museum belonging to the Chester Society of Natural Science.

According to Mr. Shrubsole the Roman coins of Chester are generally found in soil consisting more or less of disintegrated red sandstone and clay: the coins of the find now under consideration must have been buried for fifteen centuries, for such as have been deciphered belong to what is called the Roman Third Brass, and range from Philippus, A.D. 244, to Constantine, A.D. 337. Mr. Shrubsole further remarks that crystals are not found to result from the alteration of isolated coins; when met with they line cavities between adjacent coins of a pile. And this ought, perhaps, to be expected. The water which trickles through the soil and contains dissolved carbonic acid and alkaline carbonates will convert into carbonate all metallic copper to which it has free access: a single coin or a pile of coins will thus, in the course of time, be covered with a more or less protective crust of carbonate of copper: within the crust, however, the action will be that of water rather than carbonic acid, and the material will be changed to oxide. But, while in the case of an isolated coin there is no internal cavity in which crystals have space for their development, in a pile such cavities will be produced through the thrusting asunder of adjacent coins by the formation of intervening carbonate near the rim.

The products of alteration noticed in these coins are blue and green carbonates of copper (chessylite and malachite), red oxide of copper (cuprite), and yellow carbonate of lead (cerussite).

The blue and green carbonates are uncrystallised.

The red oxide of copper is often distinctly crystallised; one cavity contains some transparent cubo-octahedra and cubes of great splendency; they are nearly a millimeter in thickness.

[1] These products of alteration were exhibited at the meeting on October 20th, 1885.

The carbonate of lead, though rarely seen, is in one cavity present as a little tuft of yellow acicular crystals.

This mode of occurrence of carbonate of lead has been remarked by Lacroix :[1] the Roman coins examined by him were found in Algeria, and were those of the time of Severus, A.D. 205-234 : one of the coins was analysed by him with the following result :—

Copper	...	79·76
Lead	...	16·26
Tin	...	3·97
		99·99

On the same coins from Algeria were cubes of cuprite ; they showed no replacement either of their edges or quoins.

Cuprite is often found as a result of alteration of long buried objects of bronze. Small transparent octahedra were found on breaking fragments which had formed part of the leg of a gilded bronze horse found in the Saône, near Sainte Claire, in 1766 : red crystals were also observed in a similar object found in 1771 (or 1777) in the city of Lyon, and were proved by Sage to be chemically identical with the Cornish mineral cuprite discovered just before.[2] Buffon, however, thought that the red crystals were really an arsenic compound.[3] Nöggerath describes dodecahedra and cubo-octahedra of cuprite as results of alteration of a Roman vessel dug up at Wichelshof near Bonn in 1818-9 :[4] in this case the vessel might have been subjected to the action of fire.

Copper coins dug up from Torre del Greco after the Vesuvius eruption of 1794 had been converted into red oxide : and crystals were found on a brass candlestick.[5] The red oxide has been met with as a furnace-product ; and, after the great fire of Hamburg, copper objects were found to have been changed to the same oxide.[6]

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[1] *Société Minéralogique de France*, 1883, Vol. VI. p. 175.

[2] *Observations sur la Physique, sur l'Histoire naturelle et sur les Arts*, par Rozier et Mongez, 1779, Vol. XIV. p. 155.

[3] *Histoire naturelle des Mineraux*, 1785, Vol. III. p. 56.

[4] *Das Gebirge in Rheinland Westphalen*, 1824, Vol. III. p. 231.

[5] *Schweigger's Journal für Chemie und Physik*, 1825, Vol XLIII. p. 132. *Breislak's physische und lythologische Reisen durch Campanien*, 1802, p. 204.

[6] *Erdmann's Journal der Chemie*, 1840, Vol. XIX. p. 118. *Hausmann's Beiträge zur metallurgischen Krystallkunde*, 1850, p. 17. *Leonhard, Hütten-Erzeugnisse*, 1858, p. 365.

On the Crystalline Form of Creatine.

By L. Fletcher, M.A., F.C.S., President.

[Read May 10th, 1887.]

SOME small crystals of a substance, supposed at the time to be an allotropic modification of Creatinine ($C_4H_7N_3O$), were submitted to me for crystallographic determination. The crystals of which the angles were to be measured were thin elongated plates nearly $\frac{1}{10}$th of an inch long, $\frac{1}{100}$th of an inch broad, and $\frac{1}{500}$th of an inch thick.

Although so minute, the crystals were found to give very sharp images, and measurement of four of them led to the following results:—

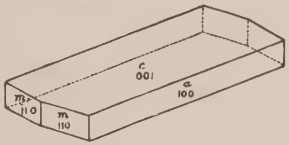
System.—Monosymmetric.

Elements.—$a : b : c = 2{\cdot}404 : 1 : 2{\cdot}479$; $\beta = 71°8'$.

Forms observed.—$a\{100\}$, $c\{001\}$, $m\{110\}$: and, on one crystal, also $e\{201\}$.

The faces of the form e are narrow, and replace the edges ac, $\bar{a}\,\bar{c}$.

The crystals are elongated parallel to the axis of symmetry, as illustrated in the accompanying figure.



Angles.	Mean.	Limits.
ac	71°8′	70°54′ – 71°13′
$c\bar{a}$	108°52′	108°48′ – 109°3′
ae	21°38′	21°38′
am	66°16′	66°11′ – 66°28′
mm'	47°28′	47°25′, 47°29′
mc	82°31′	82°30½′, 82°31′
$\bar{m}_c$	97°29′	97°23′, 97°37′

Almost accidentally, it was observed that these angles were strikingly similar to the following angles assigned by Heintz[1] and Keferstein[2] to creatine ($C_4H_9N_3O_2$):—

[1] *Pogg. Ann.* 1848, Vol. LXXIII. p. 595.

[2] *Ibid.* 1856, Vol. XCIX. p. 294.

	Heintz.	Keferstein.	
	Mean.	Mean.	Limits.
ac	71°5′	70°41′	69°43′—71°54′
am		65°49′	
mm′	46°50′	47°50′	46°48′—49°32′

The crystals of supposed creatinine were accordingly submitted to a chemical examination, and were found to be actually creatine.

As so few crystals of this substance have been measured, and the last recorded measurements were made thirty years ago, the above confirmatory numbers are worthy of record: they serve at the same time to illustrate the fact that the goniometer is still of service as a discriminating instrument.

The angles given by Heintz were obtained from a single crystal, the only one he was able to find from which satisfactory measurements could be got: those given by Keferstein were the results of measurement of five crystals.

We may add that the parametral ratios generally assigned to creatine and creatinine in works on chemistry are wrongly calculated; in each case the number assigned to the ratio $a : b$ should be divided by the corresponding value of sin β.

On a Variety of Glaucophane from the Val Chisone (Cottian Alps).

By Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S.

[Read October 25th, 1887.]

AS I was descending the Val Chisone from the Col de Sestrières last summer, my eye was attracted by the peculiar colour of an erratic, which was lying on the hillside very near the road. The violet-blue tint, generally indicating the presence of glaucophane, was perceptible, especially in certain lights, but, as it was much less strongly marked than in rocks in which I had previously observed the mineral, I felt doubtful. However, I secured a good specimen, and now find on microscopic examination that glaucophane is present, though it is a pale coloured variety, differing from those which I have hitherto examined.[1]

The block was a fairly large one, perhaps more than a square yard in area, and a couple of feet thick. I did not, however, take measurements, as the exact size was unimportant. There was no like rock visible in the neighbourhood for a considerable distance, so that I cannot say whether it had been brought down from the upper part of the Val Chisone, or along the line of a small gully from somewhere on the mountain above. Time did not permit me to attempt a search for the parent rock, which would certainly have occupied hours, and it might be days. The erratic is very near Fresnières, in the Commune of Pragelas.[2]

The rock was tough and difficult to break. The specific gravity is 3·10.[3] It is holocrystalline, rather fine-grained, and, on examination with a lens, appears composed of a dark purplish-coloured, a green, and a whitish mineral, the last being the least abundant. There is a slight, but only a very slight, approach to a foliated structure, such as may be seen in certain diorites which have been modified under pressure subsequent to their original consolidation.

Microscopic examination shows that the constituents are not now in their original condition. The principal are the glaucophane, a rather dirty-

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[1] *Min. Mag.* Vol. VII. p. 1, and p. 150.

[2] The nearest locality on record, so far as I know, is the Val di Lanzo, where pebbles of glaucophane rock were found near Germagnano. *Williams, N. Jahrb.* 1882, Bd. II. p. 201.

[3] Kindly determined for me by Dr. Plimpton, in the University College Laboratory.

looking yellowish-green mineral, and some felspar. The glaucophane occurs abundantly in transparent flakes, like those of chlorite, or needle-like actinolite, often about ·01″ by ·0015″, and frequently grouped in slightly diverging bundles. It has, in short, an actinolitic habit; cross sections showing the characteristic cleavages of hornblende are rare. The tints are pale, but there is a distinct dichroism; the long sections changing from a pale violet-blue, with vibrations parallel with the vertical axis, to a barely perceptible bluish-grey, with vibrations perpendicular to it. Transverse sections afford a moderately strong violet tint with vibrations parallel with the orthodiagonal axis, and with those perpendicular to it an extremely faint purplish or reddish-grey tint, being almost colourless. With crossed nicols the extinction angles in longitudinal sections are small, as is usual with glaucophane.[1] With ordinary light these sections exhibit a distinct though pale violet-blue tint, while a cross section is much paler, but more distinctly purple in its tint.

The yellowish-green mineral has a dirty look, as if full of dust, and so is difficult to examine. Its external form is not very definite. It often exhibits traces of a close platy cleavage, and reminds me of an altered diallage, while in other grains two cleavages may be observed, which occasionally resemble those of hornblende, but more often seem to cross at high angles as in augite. Locally we get a little green hornblende associated with this mineral. Its dichroism is very feeble, the extinction angles are inconstant, generally suggesting a hornblende, but occasionally large enough for an augite. After careful study of the mineral, I am of opinion that it was once an augite (probably aluminous), but has undergone considerable alteration. In many cases a platy structure has been set up. Further change has caused the separation of a constituent—probably the aluminous silicate—in very minute microliths, and a process of 'uralitization' has converted the remainder more or less completely into a variety of hornblende. Felspar (species indeterminable) can now and then be recognised, and there are many small grains in the slide which are probably this mineral or some alteration product. A grain or two of epidote is probably present, and I think I recognise a little quartz. There are also many small patches and granules, clustered or single, brownish or greyish, more or less opaque or earthy looking. Of the former, some may be a kaolinitic residue after felspar; others, decomposition products after an iron-oxide—perhaps in part ilmenite.

The glaucophane is generally in close relation with the uralitic mineral,

[1] *Lasaulx, Précis de Petrographie, s.v. Glaucophane.*

often bordering it or even apparently in crystalline continuity with it. I cannot doubt that the glaucophane is a secondary product in the rock. The structure of this has been greatly obscured by subsequent molecular changes, but the arrangement of the uralitic mineral suggests that the original structure was more or less 'ophitic.' I believe, then, that the rock was once a dolerite, consisting chiefly of a felspar, such as labradorite, and an augite (probably a variety rather rich in alumina). The formation of an actinolitic variety of hornblende in dolerites and gabbros is a mode of change in these rocks with which we have now become familiar. In this case, however, I imagine that some of the constituents of the augite entered into combination with the soda constituent in the adjacent felspar, and produced along the border line an actinolitic glaucophane instead of an ordinary actinolite. Thus, by the molecular rearrangement of the constituents of an aluminous augite and labradorite, has resulted a glaucophane and (probably) a felspar akin to anorthite.

On the Discovery of Leucite in Australia.

By Prof. J. W. Judd, F.R.S., Pres.G.S.

[Read October 25th, 1887.]

THE mineral Leucite has for so long a period been considered as one of the most remarkable examples of limited distribution both in space and time, that the discovery in Australia of a rock largely composed of this mineral, by Mr. T. W. Edgeworth David, F.G.S., of the Geological Survey of New South Wales, is one that appears deserving of being at once placed upon record.

Leucite-crystals, under the head of "white garnet," or "white schorls," appear to have been known from a very early period; and, indeed, the fine examples from Somma could scarcely fail to attract the attention of the older mineralogists. Subsequently it was found that the mineral occurs in other parts of Italy, and especially the neighbourhood of Rome, as well as at the Laacher See and the Kaiserstuhl.

In 1868 Zirkel published his *Basaltgesteine*, in which work it was shown that leucite is an important constituent of many lavas in Saxony, Bohemia, the Rhön Mountains and Thüringer Wald. It was not till 1874, however, that an extra-European locality for the mineral was announced by Vogelsang; that author showing that it occurs in a basalt from the small island of Bawean, North of Java.[1] Two years later Prof. F. Zirkel was able to announce its occurrence at a single isolated locality in North America, which has received the name of the "Leucite Hills,"[2] and is situated in Wyoming Territory, at a point north-west of the Point of Rocks.

It is only quite recently that Prof. O. Derby has been able to state, on the authority of Prof. Rosenbusch, that a basalt from Brazil contains leucite, and he points out that this rock is almost certainly of palæozoic age.[3] To the successive discovery of the mineral in the Asiatic, the North American, and the South American continents, we are able to add

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[1] *Neues. Jahrb. für Min. u. s. w.* 1875, p. 175.

[2] *Microscopical Petrography, U.S. Geol. Expl. of 40th Parallel* (1876), p. 259. Pl. V. fig. 4.

[3] *Quart. Journ. Geol. Soc.* Vol. xliii. (1887), p. 463.

that of its occurrence in the Australian, and it now only remains to be detected in Africa.

On hearing from my friend Mr. T. W. Edgeworth David of his important discovery, I at once asked him to furnish me with a definite statement concerning the particulars of it; and in answer to my request he writes as follows:—"The leucite-rock occurs at *Byrock*, near Bourke, in the Colony of New South Wales, about 450 miles north-west from Sydney. The lava-sheet from which I took the specimens is between 300 and 400 miles distant from the nearest sea, but, as near as I can recollect, is only about 500 feet above sea-level; and in Cretaceous times the sea must have extended from the Gulf of Carpentaria to the base of the low hill of granite on which this leucite-rock rests. I think that the sheet was about a mile long and half-a-mile broad. I was unable to spend more than a few minutes at the spot, but I hope on some future occasion to have the opportunity of making a detailed examination."

The examination of two slices of the rock, kindly sent to me by Mr. T. Edgeworth David, shows that the rock has many points of resemblance with that of the Capo di Bove near Rome and that of the Leucite Hills in Wyoming, U.S.A. The leucite-crystals are small, and occasionally exhibit the symmetrically-arranged inclusions so characteristic of the more minute rock-forming leucites; on the other hand, they only rarely exhibit the anomalous double refraction so constantly found in large porphyritic crystals of the same mineral. The leucite-crystals of the Byrock-lava contain crystals of apatite and occasionally of augite as inclusions.

The minerals associated with the leucite are augite, which occurs in minute prisms, and with the leucite grains makes up the bulk of the rock; and a peculiar biotite, of a yellow colour and distinguished by its feeble absorption and pleochroism, occurring in large irregular crystals which enclose the smaller individuals of leucite and augite: a very similar biotite also occurs in the Capo di Bove and Leucite Hills rocks. Melilite crystals I failed to detect, but olivine granules of considerable size are prominent among the porphyritic constituents of the rock. As the rock contains so considerable a quantity of olivine, it must be called, if we follow the nomenclature of Rosenbusch, a "leucite-basalt," while the Capo di Bove and Leucite Hills rocks belong to the group of the "Leucitites."

The lava contains a few inclusions of a foreign material, but a fuller description of these and of other peculiarities of this interesting rock may be deferred till other specimens of it have been obtained.

On a Specimen of Proustite containing Antimony.

By H. A. Miers, M.A., F.G.S., and G. T. Prior, B.A.

[Read October 25th, 1887.]

THE specimen which is the subject of the present note is a magnificent piece of Proustite from Chañarcillo, Chili, which has been recently acquired for the British Museum. It is a mass of lustrous crystals, measuring about 3 inches by 2½ inches, and nearly 3 inches in height.

The specimen has a peculiar cockscomb appearance, due partly to the habit of the crystals and partly to the way in which they are grouped; the lower part consists of Proustite, interpenetrated by a little minutely crystalline white Calcite, which on one side of the specimen extends partly over the crystals in the form of darker coloured acute rhombohedra.

The larger Proustite crystals have the aspect of rough triangular pyramids, with blunt apices and a ragged outline due to the smaller crystals which protrude along their edges.

The forms present are e, $\{110\}$, $-\frac{1}{2}R$; s, $\{11\bar{1}\}$, $-2R$; v, $\{20\bar{1}\}$, $R3$; P, $\{32\bar{3}\}$, $-2R\frac{3}{2}$.

In the larger crystals the faces s are prominent and form the blunt apex, while the lower parts are drusy and uneven and composed of the forms P and v, with curved faces of steep scalenohedra and prisms; on these crystals the form e only makes its appearance as linear planes, which traverse the faces of s and give rise to step-like projections upon them.

The smaller crystals, on the other hand, have the usual scalenohedral habit due to the predominance of v and are terminated by e, below which is the form s in oscillatory combination with e and truncating the acute edges of the scalenohedron v.

Intermediate between these two habits are some on which s and P are the predominating forms, although the terminations consist of e faces in superposed lamellæ.

The faces of e, s, v and P are all very bright; v is striated parallel to the lateral edges of the primary rhombohedron $\{100\}$ R; P has curved striæ nearly parallel to its intersections with s; the striæ upon e parallel to s and e, and those upon s parallel to e, are due to oscillatory combinations; the faces themselves are smooth.

The smaller crystals are invariably grouped upon the larger in twin position according to the two laws, (1) twin planes {211} $\frac{1}{4}R$: (2) twin planes {100} R. There are no doubly terminated crystals.

Except for the variations in habit the whole specimen appears to be homogeneous throughout, and has the aspect of ordinary Proustite.

Measurements (Miers).—The crystals best suited for measurements are those of scalenohedral habit, in which both the rhombohedra *e* and *s* have perfectly smooth lustrous faces. The angle between the *e* faces must be used to determine the exact form in preference to any other angle, since minute differences in the element of a rhombohedral crystal will make themselves more evident in the angles of flat rhombohedra and faces near the summit of the crystal than among such as lie near the prism zone, where the angular values are the same for all such crystals.

Three of these crystals (*A B C*) were measured with the following results, in which e_1 e_2 e_3 denote the three faces of $-\frac{1}{2}R$ which terminate each crystal.

		A	B	C
e_1 e_2	...	42°44′53″	42°45′50″	42°45′43″
e_2 e_3	...	42°45′57″	42°45′50″	42°46′23″
e_3 e_1	...	42°46′50″	42°46′33″	42°46′27″
Mean	...	42°45′53″	42°46′4″	42°46′11″

Final mean ee=42°46′3″

A fourth crystal, upon which the faces *s* were particularly well developed, gave the following values:—

s_1 s_2 = 99°21′13″
s_2 s_3 = 99°21′43″
s_3 s_1 = 99°21′50″
Mean ss = 99°21′35″ observed.
99°21′50″ calculated from ee.

In all the above measurements each angle is the mean of three observations, and may be regarded as reliable to about 15″.

The angle of the primary rhombohedron R {100}, calculated from the value ee = 42°46′3″, is 72°12′4″.

It is clear then that the rhombohedron angle of these crystals may be taken as 72°12′ within very close limits.

Analyses (Prior).—Two analyses were made: in analysis A material taken from the underside of the specimen was used, while analysis B was made on the four crystals actually measured, together with other small and

perfect crystals of precisely the same appearance all taken from the upper part of the specimen.

The material used in analysis A, although taken from the underside of the specimen, was crystalline, and when examined for adhering and enclosed impurities under the lens and during the process of crushing, seemed to be perfectly homogeneous and to all appearance true Proustite.

In both analyses the mineral was decomposed in a current of chlorine: the volatile chlorides of sulphur, arsenic and antimony were absorbed by a mixture of hydrochloric and tartaric acids, while the silver was left in the residue as chloride. The solution containing the arsenic and antimony was evaporated down to a small bulk with constant addition of potassium chlorate, and was then treated for the separation of the arsenic and antimony.

In analysis A this separation was effected by Fischer's method as modified by Hufschmidt, which consists in reducing the arsenic to arsenious acid by means of a ferrous salt, and then distilling off the arsenic trichloride in a current of hydrochloric acid gas. The arsenic in the distillate was precipitated by sulphuretted hydrogen as trisulphide, which was washed with water, alcohol and carbon bisulphide, dried and weighed. The antimony was also precipitated by sulphuretted hydrogen, and the resulting trisulphide, after being washed with water and dried, was heated to $260°-270°$ in a current of carbonic acid.

In analysis B the separation of the arsenic and antimony was effected by magnesia mixture. In order to free from magnesium tartrate, the precipitate of ammonium magnesium arsenate was dissolved in hydrochloric acid and reprecipitated with ammonia and a little magnesia mixture: finally it was converted into magnesium pyroarsenate. The antimony in the filtrate was precipitated in cold solution by sulphuretted hydrogen as pentasulphide, which was washed with water, alcohol and carbon-bisulphide, dried and weighed.

In both analyses the sulphur was determined in a separate portion of the powdered material by fusion with potassium nitrate and sodium carbonate, and precipitation of the sulphate with barium chloride: the resulting barium sulphate, after being weighed, was warmed with dilute hydrochloric acid according to the method of purification given in Fresenius, *Quant. Anal.*, §132.

Below are the results of the analyses, together with—

α theoretical composition of true Proustite.

β „ „ „ Pyrargyrite.

A′ theoretical composition of a mixture of 83·64 p.c. of Proustite and 16·36 p.c. of Pyrargyrite.

B′ ,, ,, of a mixture of 93·82 p.c. of Proustite and 6·18 p.c. of Pyrargyrite.

	A	A′	B	B′	α	β
Silver ...	64·50	64·50	65·06	65·06	65·40	59·90
Arsenic...	12·54	12·69	13·85	14·23	15·17	—
Antimony	3·62	3·65	1·41	1·38	—	22·31
Sulphur	19·09	19·16	19·64	19·33	19·43	17·79
	99·75	100·00	99·96	100·00	100·00	100·00

Weight of material used in analysis A { For determination of Ag, Sb and As ... 0·7158 gr. / For determination of S 0·4924 ,,

Weight of material used in analysis B { For determination of Ag, Sb and As ... 0·9102 gr. / For determination of S 0·3834 ,,

Specific gravity of the crystals used in analysis B = 5·638.[1]

Results.—Our results may be briefly expressed as follows :—

Rhombohedron angle.	Percentage of As.	Percentage of Sb.	Spec. Grav.
72°12′	13·85	1·41	5·64

The only analyses hitherto made together with crystallographic measurements are those recently published by Rethwisch (Neues Jahrbuch, Beilage Band IV. (1886) p. 31). His results expressed in the same way are :—

	Rhombohedron angle.	Percentage of As.	Percentage of Sb.	Spec. Grav.
Proustite	72°10′10″	15·03	—	5·5553
	71°22′27″	3·01	18·63	5·716
	71°21′30″	2·62	18·58	5·754
Pyrargyite	71°12′58″ [2]	—	22·36	5·871

[1] The above value is the mean of numerous determinations taken with all possible precautions on 2·5 grams of material by means of the specific gravity flask. The results varied considerably, the limits being 5·617—5·676. In our opinion the value of the specific gravity determined with the flask from such a small weight of material cannot be relied upon beyond the first place of decimals.

[2] This angle is liable to the objection indicated above, since it is determined from the measurement of the scalenohedron v, $R3$, $\{20\bar{1}\}$; the above value is calculated from the angle $vv = 35°10'47''$. Now an angle of 35°11′51″ would correspond to the rhombohedron angle 71°22′0″, and the measurements were certainly not reliable within one minute.

We have found the rhombohedron angle on some crystals of Proustite from Chañarcillo which are free from any trace of antimony to be 72°11′50″; that is to say, within the errors of observation, absolutely identical with the angle of Proustite containing more than 1 per cent. of antimony; and it will be seen that our crystals have no place in the series which Rethwisch professes to have established.

It may be remarked that Rethwisch does not say whether the material analysed by him consisted of the crystals actually measured; the present analyses show that this is a matter of great importance, since in our specimen, which has all the appearance of being homogeneous, the crystals measured contain 1 per cent., while another part contains 3 per cent. of antimony.

Conclusions.—The analyses prove that the antimony is very unevenly distributed throughout the specimen, and is probably present in smaller quantities in the better crystallised parts; it is even conceivable that the surface of the crystals may contain no antimony; but, however that may be, it is certain that *in the crystals here analysed the presence of more than 1 per cent. of antimony has no appreciable effect upon the rhombohedron angle.*

Whether this is always the case, or whether there are varieties intermediate in form as well as in composition between true Proustite and Pyrargyrite, can only be decided by the examination of a large number of specimens, a task upon which we are now engaged, the results of which, it is hoped, will be shortly published.

On the Occurrence of Rutile-needles in Clays.

By J. J. H. Teall, M.A., F.G.S.

[Read October 25th, 1887.]

THE discovery by my friend, Mr. Dick, of zircon, rutile, tourmaline, cyanite, &c., in the Hampstead and other sands,[1] and also the necessities of a work in which I am engaged, have induced me within the last few weeks to turn my attention in a somewhat systematic manner to the sedimentary rocks, and especially to the clays. At present I have examined only eight or nine samples of clays, but I have already come across a fact which I trust will be thought of sufficient interest to justify this communication. In examining the clays the method I adopt differs from that followed by Thurach in his classic investigations, "Ueber das vorkommen mikroskopischer Zirkone und Titan-Mineralien in den Gesteinen,"[2] only in one respect. I examine the washings which are removed by his process. The method is as follows:—The dry clay is roughly pounded up in a mortar, and the powder thus formed is placed in a sieve having 70 or 80 meshes to the inch. The sifting is effected under water in a porcelain basin. After most of the material has passed through, the sieve is removed, the water in the basin is agitated, and the turbid water is decanted. The process is repeated until only the clean grit remains. This grit contains quartz, felspar, and the heavy minerals zircon, tourmaline, rutile in orange and yellow crystals or grains, cyanite, pyrite, &c., when these are present. An average sample of the grit is examined both in water and when mounted in balsam, and also a sample from which the lighter materials have been roughly separated by vanning. The turbid water poured off during the first operation is allowed to settle in a beaker for about a minute, and then samples are taken by means of a glass tube from the top and bottom of the turbid portion.

Now I find amongst the finer material of certain clays a large number of extremely minute acicular crystals. These appear like short black bristles when examined with a low power, but under a high power and when mounted in balsam they are generally seen to be transparent and

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[1] *Nature*, Vol. XXXVI., p. 91.

[2] *Verh. d. phys.-medic. Gesellschaft zur Wurzburg Neue Folge*. Band xviii.

nearly colourless; the blackness is evidently due to a marked difference between the refractive indices of the needles and the balsam. Some needles are so thin as to be dark under a very high magnifying power: these, however, are rare. The finest needles are less than ·001 mm. in thickness; but on the average their thickness is about ·002 mm. As a rule they are from 8 to 15 times longer than broad, but sometimes they are as much as 30 times longer than broad.

Under crossed nicols the thicker needles give colour, and even the thinnest on which any observation can be made produce a marked depolarising effect. They extinguish straight in all cases, and the minor axis of depolarisation (in this case an axis of elasticity) lies parallel with the length of the crystal. Assuming the mineral to be uniaxial, this shows that its double-refraction must be positive.

The above facts are sufficient to render it highly probable that we are here dealing with rutile, and this is rendered certain by the occurrence of the characteristic twins. Rutile frequently occurs twinned, so that the principal axes of the two individuals make angles of either 65° 35′ or 54° 44′ (Rosenbusch). Now both these types of twinning have been observed several times in the needles from the clays. The angles measured do not deviate more than one or at the most two degrees from the above values, and this deviation is well within the limits of experimental error. Sometimes, though rarely, the twinning is seen to be of a complex character, suggesting the sagenite aggregates of De Saussure.

The needles in question are similar to those which have been recognised by so many observers as occurring in the clay-slates, and which are generally termed clay-slate-needles (thon-schiefer-nädelchen). They were first described by Zirkel,[1] and subsequently identified as rutile by Werneke,[2] Cathrein,[3] and Sauer.[4]

Their occurrence in the clays is therefore by no means surprising; and I should not have described them so minutely were it not for the fact that their apparent absence from the clays has been commented upon. Thurach states that he has not found them in the ordinary sedimentary rocks; but this is easily accounted for, as they are carried away with the finer material during the process of washing, and he does not appear to have examined this material. I am not prepared to say that they are

[1] *Pogg. Ann.* 1871, cxliv. 319.
[2] *Neues Jahrb.* 1880, ii. 281.
[3] *Ibid.* 1881, i. 169.
[4] *Ibid.* 1881, i. 227.

present in all clays, and they certainly vary in abundance in those specimens which contain them. In some they are extraordinarily abundant, in others they are comparatively rare. The needles must not be confused with the larger crystals and grains of rutile which are often so abundant in the finer sands and clays. The latter are probably as distinct in origin as they are in character from the former. I will now give a brief account of the mineralogical character of those clays in which I have observed the needles. The ill-defined substance (or substances) generally termed kaolin forms of course in each case the bulk of the clay. This will not be referred to.

The measurements appended will give a general notion of the sizes of the constituents.

Pipe-clay from the Bagshot Beds, Alum Bay, Isle of Wight.—Quartz grains; diameter of average grains about ·013 mm. Prisms of tourmaline sometimes terminated at one end by the faces of a rhombohedron and at the other by the basal plane, thus showing the characteristic hemimorphism; ·012 × ·02 and ·012 × ·046. Grains (·03) and crystals (·01 and ·06) of zircon. Anatase in octahedra; ·003 + ·01. Rutile-needles abundant, sometimes showing characteristic twins.

Sandy Kimmeridge Clay, Drayton.—A large number of microscopic nodules of pyrites, exactly similar in form and appearance to the well-known larger nodules; average size ·07 mm.; largest observed ·2 mm. zircon grains and crystals; ·13 × ·06 and smaller. Tourmaline. Rutile in grains and crystals; same size as zircon. Anatase in pyramidal (.02 × ·01), and also in tabular (·034 × 044) form. Cyanite in cleavage flakes (·16) giving extinction referred to trace of second cleavage of 28° and showing a negative bissectrix in convergent light. Rutile-needles scarce.

Sandy Clay containing Plant Remains from the Shaw Kiln, Newbury.—Quartz grains. Zircon in crystals, sometimes capped, and grains. Rutile in grains (·05), individual crystals and twins. Tourmaline. Black grains. Rutile-needles comparatively scarce.

Plastic Clay, Newbury.—Nodules of ferric oxide evidently pseudomorphous after pyrites-nodules similar to those described above. Quartz. The heavy minerals, zircon, tourmaline, &c., comparatively rare. Rutile-needles and twins.

Thames Mud at Kew.—Quartz grains. Zircon crystals and grains. Tourmaline. Several undetermined minerals. Many individuals and

species of diatoms. Rutile-needles scarce. The abundance of diatoms suggests that these organisms may contribute an important amount of silica to certain argillaceous deposits.

Silurian Clay, Rubery Asylum, Lickey Hill, Worcestershire.—Quartz grains. Tourmaline. Zircon crystals and grains (rare). Black grains. Pyramidal anatase in very minute crystals. Rutile-needles both single and twinned.

In conclusion, I have to state that I am indebted to my friend, Mr. Jukes Browne, and also to Mr. Bennet, for several of the specimens above referred to.

On the Nature and Origin of Clays: the Composition of Kaolinite.

By J. H. Collins, F.G.S.

[Read October 25, 1887.]

THE clays appear under many widely different aspects, and from one point of view must be studied as rocks. There are rock-masses alike of clay and of serpentine, both the result of important metamorphic processes. The basis, however, of most—probably of all—clays appears to be a substance of definite composition and well-marked characters, as much entitled to specific mineral rank as allophane or serpentine, or perhaps opal. In this paper I propose to consider clay as a rock and as a mineral.

1. *Clay as a rock.*—The kaolinisation of felspar, the incipient stage of which is indicated simply by a peculiar opacity, as in the case of the granitic rocks of Cornwall and West Devon, is sometimes very complete, and occurring over large areas results in the shape of kaolin or China-clay, or potter's and brick-clay. Such productions may be conveniently studied according as they occur *in situ* or are derived and transported.

a. Clay-masses in situ.—The chief of these is the rock known as China-clay-rock or *Carclazyte*,[1] composed of white or greyish-brown quartz, white lepidolite or gilbertite, and white orthoclase, the last more or less completely kaolinised. As accessories, schorl and brown mica (lepidomelane) are common, and cassiterite and topaz not rare. The form of the felspar crystals, often clearly distinguishable, is usually the Carlsbad macle. The China-clay-rock seldom extends more than a few fathoms on either side of the schorlaceous veins in which kaolinisation seems always to have originated, but may accompany them to a depth of 100 fathoms or more from the surface. Several of the largest China-clay works in Cornwall—as at Carclaze and Beam—were at first opened on such veins for the tin they contained.

"China Stone," or Petuntzyte,[2] is a rock similar to but less completely altered than Carclazyte, its usually abundant felspar retaining some alkali.

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[1] J. H. Collins, F.G.S., 1878. The Hensbarrow Granite District.

[2] *Hensbarrow Granite*, p. 31. This substance is ground up with clay and other ingredients in the manufacture of porcelain.

There is often a little fluor present, and the presence of white lepidolite ("shell"), and brown or black schorl may detract from or neutralise the economic value of the rock. In the parishes of St. Stephen's and St. Dennis, near St. Austell, and at Tregoning Hill, in Mount's Bay, China-stone, like the China-clay-rock, occurs in irregular bands or patches. Though as yet never worked more than a few fathoms from the surface, it is believed to continue in depth. In several localities it overlies China-clay, which it very rarely caps.[1]

The kaolinisation noticeable in the "decomposed elvans"—mostly altered felsites, quartz-porphyries, or felspar-porphyries—affords excellent material for crucibles and fire-bricks, but is practically useless as a source of China-clay.

b. Derived Clay.—Of these the following may be taken as typical examples :—

(1.) *Flucans of Mineral Veins.*—These commonly observable unctuous clay-partings or vein-fillings are among the most common phenomena. They are the product of former continued earth movements, or a sediment from fluids.

(2.) *Bovey Tracey Clay Deposits.*—These beds, interstratified with lignite, by their situation at the base of the extensively kaolinised granitic rocks of Dartmoor, suggest a derivation from those rocks by a process of natural clay-washing into a depression then occupied by a lake. The pipe-clay and potter's clay of Dorsetshire have had a somewhat similar origin.

(3). *London Clay.*—The abundance of the foreign matter in this clay is plainly due to the distance of its place of origin from that of its deposition. Mr. Sorby's remark that "the chief portion of the fine-grained clays cannot be distinguished from the products of the decomposition of felspars and other minerals which can be changed in a similar manner,"[2] I have found true in every case where I have examined clays by combined chemical and mechanical methods.

2. *Clay as a Mineral.*—The objections to regarding clay as a mineral may be reduced to two :—1st. That a crystallised or crystalline condition is a necessary character for a mineral species ; and 2nd, that the clays are not of definite chemical composition. But, by common assent, such amorphous

[1] Professor Sedgwick (*Camb. Phil. Trans.* I. pp. 104-5) says—speaking of decomposed granite-rock in general—"on a near examination it is frequently found soft enough to be cut with a spade—and it is *in that state* packed up and exported to the potteries." As a matter of fact China-*stone*, which is exported to the potteries in its raw state, is never soft enough to be cut with a spade ; while China-*clay*, which may be so cut, is never so exported.

[2] Sorby : *Anniversary Address to Roy. Micros. Soc.* 1877.

substances as allophane and gibbsite are admitted to specific rank, while the supposed variations in the chemical composition of clays result from the error of chemists in analysing manifestly impure mixtures instead of China clay,[1] which, freed from foreign bodies, has a composition agreeing very closely with that of Dana's "Kaolinite." The more perfectly an impure clay-mass is cleansed, the more nearly does the resulting material agree in composition and physical characters with that of the best commercial China-clay.

The inclusion of other minerals in natural felspar crystals, and possibly too in some instances the introduction of new substances by the kaolinising solutions, causes the final product of their change to be a mixture of two or more distinct minerals. Completely decomposed felspar, as shown by our former President, Dr. H. C. Sorby, "breaks up into granules of kaolin from $\frac{1}{6000}$th to $\frac{1}{50000}$th of an inch diameter, which have a refractive power so nearly that of Canada balsam that they are best seen when mounted or suspended in water. They are not, strictly speaking, amorphous, nor yet minute crystals, but somewhat flattened and elongated particles very similar to those obtained on reducing undecomposed felspar to a fine powder; as though the original crystalline structure had had a very powerful influence in determining their shape. The depolarising power is very high, and can be easily recognised in particles as small as $\frac{1}{12000}$th of an inch in diameter."[2] So fine are some of the particles, that when suspended in pure water they take five days to subside one foot in depth.[3]

Amongst the granules of decomposed felspar Mr. Sorby found some small needle-shaped crystals, the nature of which he did not determine, but which, if the kaolin he was examining came from Cornwall or Devon, were probably achroite. Besides these, small hexagonal or irregular scales or fibrous looking aggregates of micaceous minerals, as well as minute siliceous grains, are frequent.

At the present time more than a quarter of a million tons of China-clay are annually prepared from decomposed granite in Cornwall and Devon, besides smaller quantities in Germany, France, Spain, the United States, and notably China and Japan. The analyses given in Tables I. and II. will show how little diversity of composition there is throughout the im-

[1] This is true of nearly all the analyses given by Prof. Macadam in No. 33 of the *Min. Mag.* p. 76. and notably of Nos. 1 to 7, 10 to 15, and 20 to 27. Boase's analysis of kaolin, quoted by Mr. Butler at p. 79 of the same No., was evidently made on faulty material, as is shown by the enormous quantity of alkali.

[2] Address to the Royal Microscopical Society, 1877.

[3] *Ibid.* 127.

mense series of English China-clays; and the foreign examples examined are quite comparable with these.

TABLE I.

Analyses of Commercially Dried China-Clay.

	M. * xxx.	No. 2. Do. L. M.	No. 1. Do. L. M. *	R.	B. C. *	L. M.	L. H. B.	Treverbyn A.	Treverbyn B.	Tremayne. No. 1. Yellow.	Do. No. 2. White.
SiO_2	46·60	46·90	41·60	47·84	45·60	45·90	45·83	45·75	45·38	45·40	43·50
Al_2O_3	39·60	38·35	36·60	38·76	39·12	40·40	40·36	40·68	40·11	40·50	40·00
Fe_2O_3	·10	·09	·07	·11	·08	·04	·07	·03	·02	·12	·12
Alkalies .. : ..	·21	1·38	1·56	—	—	—	—	traces	1·17	—	—
MgO	—	—	—	—	—	—	—	0·48	0·36	—	—
CaO	—	—	—	—	—	—	—			—	—
H_2O	13·03	12·55	19·37	12·67	13·51	13·21	12·42	13·01	12·62	13·20	13·40
	99·54	99·27	99·20	99·38	98·31	99·55	98·68	99·95	99·66	99·22	97·02

	M. B.	St. Day.	Carludden, June 1876, very dry.	Menyridden, June 1876, very dry.	W. B. * 1876.	Rosemellyn.	Rosemellyn. *	Treviscoe. common.	Treviscoe. very common.	Bohemia.	Bohemia.
SiO_2 ..	45·4	45·2	49·1	46·2	46·5	45·89	46·00	49·8	48·14	43·90	48·14
Al_2O_3 ..	40·2	37·8	40·2	41·1	40·2	41·71	39·86	36·9	37·71	38·33	41·48
Fe_2O_3 ..	tr.	1·5	·4	·2	·3	·12	·13	·5	·70	and loss	
Alkalies ..	·6	1·2	—	·5	·6	—	—	·2	—	4·85	·10
MgO ..	tr.	—	·2	·2	·3	tr.	tr.	·4	—	·10	·10
CaO ..	tr.	—	—	—	—	—	—	—	—	—	—
H_2O ..	13·5	12·5	10·3	12·5	13·0	12·80	12·70	12·0	12·20	12·82	10·18
	99·7	98·2	100·2	100·7	100·9	100·52	98·69	99·8	98·75	100·00	100·00

The above were commercially dried clays, mostly of good quality and fairly well washed. The percentage of water varies from 10·18 up to 19·37 per cent., or excluding the third which was distinctly moist, up to 13·51, the average being 12·62. The 26 analyses given by Dana range from 12·47 to 15·90, the average being 14·13. All had been dried by artificial heat in the process of manufacture, and subsequently exposed to the atmosphere. The water was determined in the ordinary way by drying at 100° C, but as I had some reason to suppose that some moisture was still retained, those marked (*) were specially dried and again analysed, with results as in Table II.

TABLE II.

ANALYSES OF CHINA-CLAY. (Dried *in vacuo* over Sulphuric Acid.)

	M. B. xxx.	*No.* 1 *L. M.*	*B. C.*	*W. B.* 1876.	*T. Comm.*
Silica ...	48·10	46·10	47·40	47·82	50·60
Alumina ...	41·00	40·60	40·52	41·43	37·60
Ferric Oxide	·10	·09	·09	·30	·49
Alkalies ...	·21	1·62	·10	·39	·20
Magnesia ...	trace	trace	·25	·29	·41
Lime ...	trace	trace	·22	·11	·10
Organic Matter soluble in Alcohol.	·02	·10	·04	·10	·10
Water ...	10·13	10·77	10·61	10·50	10·40
	99·56	99·28	99·23	100·94	99·90

Here the range is very small and the average percentage of water is but 10·5. This may be still too high, although I do not think it is; it cannot possibly be too low.

In the large number of samples of China-clay from different countries which I have analysed and examined during the past 15 years, I have noticed two characteristics:—

1st. An entire absence of scaly or flaky particles when the clay has been adequately washed. These foreign bodies are pretty easily separated, especially in bulk. True kaolin, instead of being "made up largely of pearly scales" (Dana), is in general, and always when properly prepared, absolutely free from them. The hexagonal scales "which may be detected in all [improperly prepared] kaolin," on which Johnson and Blake, followed by Dana, founded their orthorhombic mineral kaolinite, do not appear to have been separated and analysed. They may, indeed, be identical with the Anglesea kaolinite, or they may be lepidolite, gilbertite, nacrite, or sericite, for anything which appears in their paper.[1]

2nd. A great uniformity of composition. This is shown in the foregoing analyses.

Furthermore, it seems well-nigh impossible to make the composition agree with the typical formula adopted by Dana, and after him by most other writers on mineralogy. China-clay properly purified by careful washing, when dried *in vacuo* has invariably a composition very closely agreeing with that given under *a*, Dana's type composition being as under *b*.

[1] See S. W. Johnson and J. M. Blake. *Am. Journ. Science*, 2nd series. Vol. 43, p. 351.

			a.	*b.*
Silica	...	...	48·0	46·3
Alumina	...	...	41·2	39·8
Water	...	...	10·8	13·9
			100·0	100·0

The discrepancy here observed may appear small for an amorphous substance; but I think it is of such a nature as both to prove the inaccuracy of Dana's deductions and to point to a more simple formula.

The composition given in *a* answers to the formula $Al_2H_6O_6SiO_2 + Al_2O_3$, $3\ SiO_2$; in other words, one half of the alumina is present as hydrated silicate, the other half as an anhydrous tersilicate. Dana's formula, on the contrary, is $2\ (\frac{1}{4}\ H_2O_3\frac{3}{4}Al_2O_3)\ 3\ Si\ O_2$, or $Al_2O_3,\ 2\ SiO_2 + 2\ H_2O$— in other words, all the alumina is in the same state of combination.

Now experiment supports the first formula; for if kaolin be treated with hot sulphuric acid, about half of the alumina is at once dissolved out: the other half remains in combination with the silica, but may be very slowly got out by repeated treatment with the acid.

That Dana's adopted percentages are wrong is shown, I think, by his own table, which gives, out of 26 analyses, no fewer than 6 having the alumina *above* the type proportion as it stands, besides many others where it would be in excess if extraneous matter were eliminated, or if the totals of silica, alumina, and water were calculated up to a total of 100. This would be still more noticeable if the water were to be reduced by about 3 per cent., as it should be according to the indications afforded by Table II. on the preceding page. Making these various corrections the average alumina in Dana's table comes out very close to 41 per cent.

I may here remark that the composition of the Anglesea kaolinite, first determined by Mr. Charles Tookey,[1] if corrected about 4 per cent. for (assumed) retained moisture, as under *c*, agrees with *d*, which is almost identical with the type analysis *a* already given.

			c.	*d.*
Silica	...	...	46·53	48·56
Alumina	...	...	38·93	40·90
Water	...	...	14·94	10·94
			100·40	100·40

If this be accepted as the true composition of the mineral, then the kaolinite of Dana may be looked upon as the crystalline form of kaolin.

That some correction for moisture is necessary is evidenced by the

[1] See *Percy's Metallurgy*, *Introduction*, *Refractory Materials*, *&c.*, 1875, p. 93.

pearly lustre of the mineral, generally a sign of hydration. But there is some reason to believe that a larger correction for moisture is necessary, for a sample which I was enabled to examine by the kindness of Dr. Percy, after preservation for many years by him, gave when dried over sulphuric acid *in vacuo* only 8·40 per cent. of water.

3. *The Process of Kaolinisation.*—China-clay rock and China-stone have usually been referred to as "decomposed" or "disintegrated," and many writers have briefly referred to kaolinisation, treating of the occurrence of tin-ores, or of atmospheric effects upon rocks. These writers may be grouped as follows:—

a. Those who speak of "talcose-granite" or "protogine"[1] as the source of kaolin. "Protogine" as defined by these writers, viz. a compound of *quartz*, *felspar*, and *talc*, is now known to have been founded on a mineralogical mistake. I have as yet never met with a granite containing so much as two *per cent.* of magnesia, which is usually present only in traces, or altogether absent. Certainly there is no such thing as *talc*, *talcose-granite*, or *protogine*, in the kaolin districts of the West of England, where probably gilbertite has been mistaken for talc.[2]

b. Another class of writers, as Page,[3] for instance, confound the decomposed rock with its later-formed derivatives. As I have elsewhere shown, kaolin is not found in beds and masses along stream-courses, and the richest and purest deposits do not occur in low grounds or farthest from the sources of disintegration. On the contrary, the only kaolin pure enough to be used commercially is obtained from the hills, and *in situ*.

c. Yet other writers attribute the metamorphosis of felspar to carbonic acid gas, acting from above or below.[4] This is probably efficacious as

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[1] Hawkins. *Trans. Roy. Geol. Soc. Cornwall*, IV. p. 372, &c.
Henwood. *Ibid.* V., pp. 17, 43, &c.
Lyell. *Students' Geology.* 1st edition, 1871, p. 541, &c.

[2] The composition of these two minerals is as follows:—

	Gilbertite, from Stenna Gwynn.	*Talc.*
Silica ...	45·10	62·58.
Alumina ..	36·00	—
Ferrous Oxide	1·10	1·98.
Lime ..	1·50	—
Magnesia ..	·91	35·40
Potash ..	11·40	—
Fluorine ..	·54	—
Water.. ..	3·70	0·04.
	100·24	100.00.

[3] *Economic Geology*, p. 184.

[4] Lyell: *Principles of Geology*, I. p. 413, 1867.

regards the kaolin of Auvergne, where there is a "continual disengagement of carbonic acid from numerous fissures;" but it seems to me that the entire absence of this gas and of carbonates in the clay districts of Cornwall and Devon affords a plain indication that, here at least, some other metamorphic agent has been at work, since all the phenomena indicate that the action has been from below.

d. Von Buch and Daubrée believe that kaolinisation is produced by fluids containing fluo-silicates or fluo-borates acting from below, generally if not always through fissures. There is no proof that such fluids are now present in the fissures, but the frequent occurrence in granites and porphyries of *schorl*, *topaz*, *gilbertite*, and other minerals containing fluorine, led these geologists, as well as Elie de Beaumont, to conclude that when oxide of tin was associated with them its presence was due to the same element. In support of this view Daubrée cites his production of crystals of oxide of tin by passing vapours of stannic chloride and steam through a heated porcelain tube.[1]

Von Buch early observed the constant occurrence of kaolin with minerals containing fluorine, and suggested that the kaolin of Halle owed its origin to hydrofluoric acid.[2] Daubrée, writing of the kaolin near St. Austell, remarks that it must have had a very similar origin.[3]

The decomposed granite of Cornwall and Devon is generally if not invariably accompanied by lepidolite containing fluorine. There is also almost always schorl, and very frequently gilbertite, and sometimes topaz or fluor-spar. This latter is scarce, I believe, only because of the absence of lime, as already intimated. Briefly, we may say fluorine is *always* present in some form or other, a fact strongly in favour of Von Buch's theory. Furthermore, it would appear that the action of fluorine and boron on oxide of iron in the presence of silica has resulted in the almost universal presence of schorl, and where lime was present we have now fluor-spar.[4]

4. *Artificial Kaolin.*—Having fully considered kaolinisation from the point of view of Von Buch and Daubrée, I naturally tried experiments

[1] *Annales des Mines*, XX. 1841. He used perchloride of tin, as being more readily obtained than the corresponding fluoride; but he argues, and few chemists will dispute it, that similar results would follow from the use of the fluoride. The use of the chloride instead of the fluoride may explain why the artificial oxide differed in form from the natural.

[2] *Min. Tasch.* 1824.

[3] *Ann. des Mines*, 1841.

[4] See, for fuller details, my paper on "Cornish Tinstones and Tin Capels," *Min. Mag.* IV. pp. 123, 124, 1882.

on felspar and granite with hydrofluoric acid. I at first employed a leaden tube at a high temperature, through which the vapour acid was passed. As was to be expected, the felspar was rapidly converted into hydrated silicate of alumina, mixed with soluble fluoride of potassium, while pure silica was deposited on the sides of the tube.[1] In later experiments, I have found it preferable to use a dilute solution of hydrofluoric acid at ordinary temperatures. Contrary to what is generally stated, orthoclase seems to be much more readily and completely affected by fluorine than either albite or oligoclase. Labradorite is decomposed only in spots, obsidian also, but very slightly. It is probable that a great many minerals are capable of being thus "kaolinised," and not merely the felspars. The following analyses show what was effected by 96 hours' treatment of orthoclase with hydrofluoric acid at a temperature of 60° F :—

	a.	*b.*	*c.*
Silica	63·70	49·20	44·10
Alumina ...	19·76	35·12	40·25
Potash ...	13·61	·12	·25
Soda	2·26	trace	trace
Ferric Oxide ...	·71	trace	trace
Water	trace	14·20	15·01
	100·04	98·64	99·61

a. is the original felspar analysed by Mr. A. H. Church.

b. is my analysis of the inner layer of the altered felspar, and *c.* that of the outer layer, both dried at 100° C.

The artificial clay so produced, when examined with high powers under the microscope, exactly resembled ordinary well-prepared kaolin. It was entirely free from hexagonal scales, but contained a number of minute colourless cubes, which were probably fluor-spar.

5. *Conclusion.*—It seems to me that this series of experiments and results, taken in conjunction with the facts which I have cited, is quite sufficient to show that the hypothesis of carbonic acid, acting from below, for ordinary kaolin districts, is untenable, particularly as it does not in any way account for the universal presence of minerals of secondary origin containing fluorine, nor for the frequent occurrence of tin-oxide. There is still more reason for rejecting the hypothesis of carbonic acid

[1] Communicated to the Royal Institution of Cornwall some years since

acting from above. Whether as a constituent of the atmosphere or as a solution in water, it cannot have produced veins and bands of carclazyte extending far below the drainage-level of the country. As regards the kaolinisation of felspathic rocks *in situ*, I believe that the hypothetical conclusions of Von Buch and Daubrée are worthy of general acceptance.

Derivative clay-beds are of course formed to some extent by the subaerial denudation of carclazyte and kindred rock-masses—already kaolinised. Apart from such masses, however, it is highly probable that the carbonic acid of the atmosphere plays a great part in the production of derivative clays by chemically acting on the surfaces of felspathic and other rock-silicates, and so assisting mechanical action, frost and other denuding agents: also by converting abraded particles of such rocks into kaolin.

Note on the Occurrence of what may prove to be a new Mineral Resin.

By J. Stuart Thomson.

[Read October 25th, 1887.]

THIS resin is found in small quantities in the coal from pits at Fauldhouse, Midlothian. It usually occurs in layers not more than $\frac{1}{16}$th inch thick, accompanied by much mineral charcoal, from which it is nearly impossible to separate it perfectly. The colour is dark reddish brown, the streak being somewhat paler. As it does not melt without decomposition, its fusing point cannot be determined. When heated on platinum foil, it froths up, burns with a smoky flame, and leaves a large carbonaceous residue. When burning, the smell recalls that of incense. The resin, when distilled in a closed tube, yields a black thick viscous distillate, with a strong aromatic smell.

It is but slightly soluble in shale spirit and absolute alcohol, readily soluble in benzol, ether, and chloroform, and on evaporation of the solvent it is left as a dark brown brittle substance. Solution in chloroform and subsequent evaporation is, in fact, the best means of separation from the mineral charcoal with which it is so intimately mixed.

The resin, purified by solution in chloroform, gave when distilled with soda-lime indications of the presence of traces of nitrogen. It is also soluble in strong sulphuric acid; from which, on dilution with water, it is precipitated, apparently unaltered, as a slimy mass.

The identification and classification of many of the organic minerals is a matter of such great uncertainty, that I submitted a specimen of the resin to Mr. Fletcher, who reported "that on comparing it with the "resins in the National collection, there is a difference in its appearance. "It most nearly resembles Schraufite, Pyroretinite, and Ajkite. It may "be a constituent of one of the known resins: indeed the resins are "really so 'mixed' that the existence of species may be doubted." From my own examination it most closely resembles Schraufite, and as Schröckinger[1] seems to include several nearly allied resins under this name, it would be premature to consider the Fauldhouse specimen as a new variety, at least until a more thorough examination has been made.

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1 *Verh. Geol. Reichs.* 1875, 134.

Obituary Notice of E. H. Furuhjelm.

ON the last day but one of the past year, on the 30th December, 1886, one of Finland's most prominent miners, Enoch Hjalmar Furuhjelm, the Intendant of Mines, was suddenly cut off. Mr. Furuhjelm having been a Member of the Mineralogical Society, the Secretary has requested me to write a short memoir of the deceased for the Journal of the Society, and feeling highly honoured by this request I give the following sketch of Mr. Furuhjelm's public career.

The life of Enoch Hjalmar Furuhjelm exhibits a rich variety of researches and ardent labour in the department of mining industry, which doubtless for him would have opened a future with a more extensive sphere of activity than that in which he has now closed his days, had not his great longing for quiet and warm attachment to his native country made him devote all his abilities to its service.

After completing his preparatory studies at home, he went to Freiberg in the year 1847, and at the famous Academy of that town he increased his stock of knowledge, of which he then had opportunity to make practical use during a journey in the year 1850, when he visited Saxony, Styria, Carinthia, Carniola, The Tyrol, Bavaria, the Hartz and Sweden.

He had scarcely returned to Finland, when he was appointed Mining Engineer and Chemist at the Mines of Count Sergei Stroganoff in the Ural. There he remained till 1853, occupied with divers mineralogical researches in the Ural range, and making geological examinations in the valley of the river Tscheswo, and in the coal formations along the river Kyn in the Perm Government. From 1853 to 1862 Mr. Furuhjelm served the Russian American Company as a mining engineer. About this time he issued several publications, such as a topographical map of the environs of the Fort Novo Archangelsk, on the Island of Sitka, a geological survey of the so-called Indian Archipelago between Sitka and the North American Continent, and a geological examination of the Unalaschka Islands belonging to the Aleutian group. In the year 1856 he founded a settlement at Cook's Passage at the English Bay, and from 1859-62 he was the inspector of this settlement. During his engagement in the service of the above-mentioned Company he made extensive journeys, and visited the copper works in Chili and California as well as the gold washings

on the Western slope of the Sierra Nevada. When he resolved to give up his situation in the service of the Company and to return to Finland, he made a tour on his return journey through the United States of North America, South Wales and Belgium.

From 1865-67 Mr. Furuhjelm was the Director of the Geological Survey of Finland, just then commenced. Later he undertook an official journey to Acoz in Belgium, where he stayed two years.

The geologic-paleontological material collected by Mr. Furuhjelm at Sitka has been described by Heer in his *Flora Fossilis Alaskana*, which publication also contains Mr. Furuhjelm's description of the geological formations of Sitka. In 1874 Mr. Furuhjelm was elected a member of the Geological Association of Stockholm, in 1875 a member of the Iron and Steel Institute in London and of the Imperial Russian Mineralogical Society in St. Petersburg. In 1880 he became a member of the Mineralogical Society of Great Britain and Ireland. In 1882 he was appointed Vice-President of the Jury for Group IV. of the Universal Russian Exhibition in Moscow.

Such was in short the public life of this energetic and laborious man. A man in the finest significance of the word, endowed with a noble and feeling heart, hidden behind an exterior somewhat harsh and rough, from his early life having been so full of hardship and struggle.

May he rest softly and peacefully in the grave, which so unexpectedly closed over him!

HJALMAR GYLLING.

Helsingfors, October 1887.

Abstracts.

Ueber die Natur der Glasbasis sowie der Krystallisationsvorgänge im eruptiven Magma. Von Dr. A. Lagorio. *Tscherm. Min. Mitth.* Band VIII. p. 421.

This communication represents many years of work. It covers over a hundred pages, and contains a hundred and two original analyses. The main body of the work is divided into two parts. The first contains a statement of the observed facts; the second is taken up with a discussion of the results. In the introduction the author describes the methods of observation, and makes a few general remarks which indicate his point of view. A magma may become crystalline either by the *simultaneous* development of several different molecular groups (minerals), or by the *successive* crystallisation of different compounds. In the latter case *one and the same compound is never formed at two different* periods. Minerals belonging to the same group (*e.g.* felspars) may be formed at two different periods, but when this is the case they have not the same composition. The author considers that the laws which regulate the separation of minerals in igneous magmas have been to a great extent obscured by the common practice of considering simply the molecular relations of the silica, sesqui, and mon-oxides; thus lumping together the alkalies and alkaline earths. K_2O and Na_2O behave very differently in the formation of crystalline compounds, and have very different affinities for CaO and MgO. Rosenbusch has stated that minerals separate according to a law of increasing acidity. This empirical law is not supported by any established chemical principles, and is moreover contradicted by many facts. It appears that the separation of minerals is governed by a number of subtle chemical and physical conditions. From the fact that many rock-forming minerals may be formed both in the wet and dry ways, the author draws the conclusion that the affinities of the chemical constituents are to a great extent the same in aqueous solutions as in molten magmas, and that the general laws established with reference to crystallisation from aqueous solutions are applicable to crystallisation from igneous magmas.

The first part of the record of experimental work deals with rocks containing a high per-centage of silica, and especially with the spherulitic

liparites and rhyolites. Twenty-eight analyses are given. These analyses show (1) that the spherulitic bodies are somewhat richer in silica than the containing glass, (2) that they contain (relatively to potash) more soda than the glass. It follows, therefore, that in a magma containing much silica and alkali, and comparatively little lime and magnesia, the soda compounds have a greater tendency to separate out in crystalline form than the potash compounds. Moreover, seeing that the soda-silicate contains a higher silica percentage than the potash-silicate, it follows that the more "basic" potash-silicates succeed the more "acid"[1] soda-silicate. As regards the formation of felspars the analyses point to the conclusion that when the ratio of $K_2O : Na_2O$ is above a certain quantity—about 2 : 1—a sanidine more or less rich in soda is formed; when it is below this point a triclinic soda-felspar is formed.

It will be observed that the results of Lagorio show that the common opinion that the spherulites possess the same chemical composition as the containing glass requires modification. Considering the number of his analyses, the care with which they have been executed, especially as regards the alkalies, and the wide area from which the rocks were collected (Lipari, Teneriffe, Hungary, the Crimea, and America), it is impossible to set aside his results as exceptional. We quote five of the twenty-eight analyses.

	I.	II.	III.	IV.	V.
SiO_2 ...	72·35	73·21	73·05	74·52	73·42
Al_2O_3 ...	13·97	12·90	14·67	12·97	14·29
Fe_2O_3 ...	1·29	2·10	0·89	2·02	1·01
CaO ...	0·72	0·88	0·97	0·92	1·00
MgO ...	0·46	0·27	0·26	0·25	0·43
K_2O ...	5·38	4·75	5·11	4·53	3·19
Na_2O ...	3·58	4·83	3·99	4·26	5·61
Loss ...	1·37	1·04	0·91	0·83	0·84
	99·12	99·98	99·85	100·30	99·79
Sp. Gr.	2·132	2·112	2·21	2·089	2·523

I. Spherulitic obsidian. Lipari. Glass.
II. Spherulite from the above.
III. Spherulitic obsidian from Teneriffe.
IV. Spherulite from the above; outer part.
V. Ditto ditto inner part.

[1] In Rosenbusch's sense; not in the true chemical sense.

The author next deals with the rocks containing a medium percentage of SiO_2—the andesites and trachytes. Analyses of the rocks, of the bases, and of the felspars are given—26 in all; from these we select the following at random :—

	I. (Rock.)	II. (Groundmass.)	III. (Felsp.)	IV. (Rock.)	V. (Base.)	VI. (Felsp.)
SiO_2 ...	68·32	74·76	56·53	67 30	72·44	62·21
Al_2O_3 }	19·61	13·66	26·59	20·75	16·28	19·29
Fe_2O_3 }		2·36	1·05			1·08
CaO ...	4·24	2·17	9·60	2·63	0·59	1·18
MgO ...	1·95	0·53	—	1·05	0·20	0·05
K_2O ...	1·45	2·05	0·80	4·60	6·49	12·00
Na_2O ...	4·06	2·96	6·11	2·75	2·12	2·54
Loss ...	0·54	0·82	0·02	0·34	1·35	1·05
	100·17	99·31	100·70	99·42	99·47	99·40
Sp. Gr.	2·765	2·618	2·685	2·541	2·254	2·567

	VII. (Rock.)	VIII. (Base.)	IX. (Felsp.)	X. (Rock.)	XI. (Base.)	XII. (Felsp.)
SiO_2 ...	62·54	70·19	55·42	57·76	65 05	53·95
Al_2O_3 }	23·56	17·19	28·01	18·39	17·60	27·45
Fe_2O_3 }			1·09	7·51	3·10	1·09
CaO ...	4·75	2·50	9·12	6·21	3·58	11·48
MgO ...	1·15	0·53	tr.	3·34	1·05	tr.
K_2O ...	2·43	3·89	0·79	2·61	4·16	0·79
Na_2O ...	3·16	3·30	5·10	3·63	3·54	4·51
Loss ...	1·75	2·31	0·52	0·94	1·56	0·48
	99·34	99·91	100·05	100·39	99·64	99·75
Sp. Gr.	2·694	2·414	2·689	2·664	2·375	2·690

I. Dacite from Mojanda, Quito.

II. Groundmass of I.

III. Felspar from I. This felspar lies between $Ab_4\ An_3$ and $Ab_1\ An_1$. Extinction on M, $-12°$; on P, $-3°$.

IV. Trachyte from Mte. Amiata, Tuscany.

V. Glassy base of IV.

VI. Felspar from IV., Sanidine.

VII. Andesite (trachytic type) from Illiniker Thal, Hungary.

VIII. Glassy base of VII.

IX. Felspar from VII. Answers to $Ab_1\ An_1$ Labradorite.

X. Vitro-andesite, ejected block from Menapi, Java, Dec. 1876.
XI. Base of X.
XII. Felspar from X ; answers to $Ab_1 An_2$.

In discussing the analyses the author points out that there must be a relation between the composition of the magma and the crystals which separate out of it. Seeing, however, that the minerals form successively, it by no means follows that this relation is exhibited by comparing the analysis of the porphyritic crystals with the bulk analysis of the rock. The porphyritic felspars, for example, form after the ferro-magnesian constituents, augite, &c. Hence the magma out of which the felspars separate is not represented by the whole rock, but by this minus the earlier formed crystals. By combining analyses V. and VI., and taking into consideration the relative amounts of sanidine and groundmass, he ascertains that the magma out of which the sanidine separated must have possessed the following composition :—SiO_2 69·88, $Al_2O_3 + Fe_2O_3$ 17·30, CaO 0·71, K_2O 7·78, Na_2O 2·22. This gives 1 : 2·3 as the ratio of $Na_2O : K_2O$. Inasmuch as the pyroxenes are among the earliest minerals to form, it follows that there is a direct relation between their composition and that of the rock, a fact established by the researches of Mann, Merian and Doelter.

The author's results confirm the generally accepted view as to the effect of crystallisation in andesitic magmas ; the magma remaining after a certain amount of crystallisation is richer in silica, poorer in lime, iron and magnesia, and richer in potash relatively to soda.

Rocks containing a medium percentage of silica and a high percentage of alkalies are next considered, and then those which contain a low percentage of silica. The latter are treated of in two sections, according as they possess a low or high percentage of alkalies.

	I. (Rock.)	II. (Glass.)	III. (Rock.)	IV. (Glass.)
SiO_2	52·87	52·68	40·48	40·64
Al_2O_3	16·36	18·28	8·93	34·78
Fe_2O_3	10·87	9·43	20·05	
CaO	7·94	8·04	13·03	7·25
MgO	5·23	4·68	11·12	5·15
K_2O	0·96	1·15	1·26	3·50
Na_2O	3·64	3·86	2·05	3·04
H_2O	1·22	1·02	3·37	5·17
	99·09	99·14	100·29	99·53
Sp. Gr. ...	2·793	2·773	2·931	

I. Vitro-basalt from Schwarzenfels, Rhön.
II. Glassy base of I.
III. Limburgite from the Kaiserstuhl.
IV. Glassy base of III.

The tendency of sodium-silicates to separate out in preference to potassium-silicates is illustrated by the fact that where nepheline occurs it precedes the felspars. In all magmas iron, lime, and magnesia have a strong tendency to separate out. Where lime is present alone, or associated with only small amounts of magnesia and potash, it may reach a high percentage without the magma becoming saturated. The portion of the paper which deals with experimental work concludes with an account of experiments on the fusion of various rocks and minerals with the chlorides and (in one case) sulphates of the alkalies. These experiments show that both acid and basic rocks will take up a considerable quantity of the alkalies under these circumstances, but that there appears to be a definite limit to the amount which they will so take up. Under the same conditions sodium is taken up in slightly greater quantity than potassium. The experiments with minerals, epidote, albite, adularia, and leuchtenbergite, were made for the purpose of illustrating the relation between the alkalies and alkaline earths. The principal results may be summarised as follows :—

(1.) Epidote fused with the mixed chlorides or sulphates of sodium and potassium in atomic proportions takes up sodium much more readily than potassium.

(2.) A mixture of albite and adularia fused with calcium chloride gives rise to a product in which the alkalies are to a very large extent replaced by lime. Sodium, however, is less completely replaced than potassium. In original mixture Na : K = 1 : 1 ; in fused product Na : K = 2 : 1.

(3.) Leuchtenbergite fused with a mixture of KCl and NaCl in atomic proportions takes up potassium more freely than sodium, but takes up neither so readily as epidote.

All these points are in accord with the known composition of rock-forming minerals. Calcium-silicates frequently contain alkalies ; magnesium-silicates containing alkalies are rare. K_2O is the alkali usually found in magnesium-silicates ; Na_2O, on the contrary, is the common alkali in calcium-silicates.

The alkalies form, by preference, acid compounds ; the alkaline earths and iron-oxides form basic compounds.

In the cooling of silicate magmas compounds of CaO, MgO, and FeO first crystallise out ; then follow Na compounds, and finally K or K Na

compounds. If K is present in great excess its compounds may crystallise out before those of Na, but there still remains a magma relatively rich in K.

The third part of the paper is more or less theoretical. It may be described as an attempt to bring into relation the facts known with regard to artificial glasses, igneous rocks and saline solutions. Silicate-magmas are regarded as solutions, and the laws established with reference to the separation of salts from saturated and super-saturated solutions are applied to explain the phenomena of igneous rocks. In the first place, the researches of Dumas,[1] Benrath,[2] Pelouze,[3] and others on the character and composition of artificial glasses are referred to. The results of these researches may be thus summarised. Molten silicate solutions become less readily saturated with silicates of alumina and potash than with silicates of soda. CaO, MgO and the oxides of the heavy metals readily saturate silicate solutions, and therefore readily separate out, partly as oxides (*e.g.* Fe_2O_3). The fact that potash-glass is less subject to devitrification than any other is correlated with the fact that the basis of eruptive rocks is always richer in potash than the rock taken as a whole.

As regards the formation of spherulites in the acid rocks, the author insists on the fact that these bodies are proved by his analyses to be always richer in silica and soda than the matrix. In the preparation of glasses sand is mixed with carbonates and sulphates so that CO_2 and SO_3 are liberated in the fusion. The formation of spherulites is frequently determined by the non-escape of gas bubbles or by the presence of unfused portions of the original material. Spherulites in igneous rocks are, he considers, especially abundant where gases and vapours have passed through the magma.

Rock-magmas are more or less saturated solutions of various silicates. The most probable assumption is that the silicates are present in the solution as definite compounds, that is, as definite molecular groups. The evidence of this is that the rock-forming minerals constitute a small group, and the same minerals separate out of various acid and basic magmas. Seeing that minerals of the same species may vary considerably in composition, owing to isomorphous replacements, the definite compounds present in solution are the fundamental compounds which go to build up the different minerals. The author then gives an

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[1] *Chim. app. aux Arts.* Article "Verre."

[2] *Beiträge zur Chem. d. Glases.* Dorpat, 1871, 41.

[3] *Compt. Rend.* 1857, 47, 693.

account of the principal facts which have been established with reference to saline solutions. One or two of the most important of these may be here referred to. Soret has shown that if different portions of a solution be at different temperatures the salt will tend to accumulate in the colder portions.[1] In the cooling of saline solutions the excess of the salt first crystallises, and then the cryohydrate—a mixture of salt and water.[2]

A liquid may be cooled below its fusing point without solidification. When it solidifies the temperature is raised to the fusing point. The same is true for super-saturated solutions; the temperature becomes raised when crystallisation takes place. The view of Bunsen, that there is no essential difference between fusion and solûtion, has been confirmed by subsequent observers.

Accepting this view, what then must be regarded as the solvent medium in natural silicate-solutions? The author's analyses point to the conclusion that this is a silicate of the composition $R_2O.2SiO_2$, where R = K; with which, however, Na is in all probability associated. The silicates $RO.2\ SiO_2$ and $\dot{R}_2O_3.6\ SiO_2$, where R = Ca and $\dot{R}$ = Al, also play a similar rôle, but never alone; always in combination with the first. The first mentioned silicate, which the author terms "normal glass," will dissolve SiO_2, bases and silicates, until it becomes saturated. By rapid cooling the solution may be made to consolidate as a glass. MgO and oxide of iron show, however, a strong tendency to separate out of it. Normal glass will dissolve much alumina without prejudice to its amorphous condition, but it is very sensitive to oxides of the heavy metals and magnesia; to the latter especially when alumina is present, as is shown by the formation of spinel. SiO_2 behaves similarly. By considering these relations of the solvent medium we can explain why certain minerals, such as quartz and leucite, mutually avoid each other; and why certain others, such as quartz and olivine, occur together. Sorby has shown that the solubility of salts, which increase in volume as they pass into solution, is lowered by pressure; in other words, pressure tends to make them separate out. This is the case with the rock-forming silicates. The solvent medium (glass), on the other hand, will follow Thomson's law, and have its fusing point raised by pressure. Hence

[1] *Ann. Chim. Phys.* 1881 (5), 22, p. 293. The principle here referred to, if of general application, must be of the very first importance. It shows how a differentiation may arise in a homogeneous mass of molten material, and may serve to explain many phenomena of plutonic rocks.

[2] Guthrie. *Phil. Mag.* 1875 (4), 49. *Ibid.* 1876 (5), 1 p. 49.

porphyritic crystals formed under pressure may be partially dissolved and corroded when the pressure is diminished. The author does not consider that the corrosion of porphyritic crystals, so commonly seen in eruptive rocks, is due, as Rosenbusch supposes, to the "acidifying" of the magma. It may, however, be due in certain cases to a change in the composition of the magma, or even to the temporary elevation of the temperature of a mass of cooling material consequent upon rapid crystallisation after supersaturation has been reached. The principle of Soret furnishes a plausible explanation of the occurrence of glassy matter in the centre of a dyke. If the molten mass remains stationary for any length of time liquation will take place, and the basic compounds will concentrate in the marginal portions, leaving the central portions richer in the "normal glass."[1]

If a silicate-solution composed of different compounds be cooled below the fusing point of these compounds—in other words, if it become supersaturated—then it may consolidate rapidly throughout its entire mass, and produce a rock of granitic structure. Slow crystallisation is not likely to develope the granitic structure, which is characterised by the fact that the different minerals mutually interfere with each other. The conclusion is reached, therefore, that the granitic structure implies rapid crystallisation. This does not exclude slow cooling; indeed, it requires it, for without slow cooling the necessary over-cooling or supersaturation could not be attained.

Supersaturation depends on temperature. Gradual diminution of temperature causes a magma to become successively supersaturated with different compounds. Solutions strongly supersaturated with a certain salt readily yield large crystals of that salt. Decrease of pressure or increase of temperature in a magma in which crystals are present will cause a portion of these crystals to be dissolved. When cooling again takes place a second generation of crystals will be formed. The composition of the constituents of the second generation will depend upon the composition of the magma; their general mineralogical character will, on the other hand, depend upon that of the first formed crystals with which they are isomorphous. Since the size of the crystals depends on the amount of supersaturation, those of the second generation will be smaller than those of the first, because the presence of crystals in a solution pre-

[1] This explanation may apply to the Eskdale Dyke described by Dr. Geikie, Roy. Phy. Soc. Edin., Vol. V. 1880, p. 219. The analyses of the vitreous and crystalline portions of this dyke are exactly such as they should be, according to theory. J. J. H. T.

vents a high degree of supersaturation as regards the compounds which form the crystal or are isomorphous with these. The experimental part of the work has established the fact that the following compounds will saturate silicate-solutions in the order in which they are mentioned: K-compounds and SiO_2, Na-compounds, Ca- Mg- Fe-compounds and the oxides. In other words, those first mentioned are the most soluble, those last mentioned the least soluble. If we consider the above compounds in relation to supersaturation their order will be reversed, for the more soluble salts always furnish supersaturated solutions more readily than those which are less soluble.

Large well-developed crystals are rapidly formed from supersaturated solutions. The porphyritic crystals of igneous rocks accord with the view that they have been formed under these conditions. Orthoclase, sanidine, and leucite occur in the largest crystals; then follow quartz and the lime-soda felspars, and lastly come the normal silicates (augite, hornblende). The more insoluble salts can only form large crystals by slow crystallisation. If we assume a solvent medium, we find a natural explanation of the phenomena of crystallisation in igneous rocks by supposing that the crystallisation is determined by the following factors:—the influence of the mass of the dissolved compound, the affinities of the bases for each other, and the readiness with which the different compounds will furnish supersaturated solutions.

The general order of separation of compounds is as follows:—Oxides, Fe-silicates, Mg-silicates, Fe+Mg−, Mg+Ca−, Mg+K− (or Fe+K−), Ca−, Ca+Na−, Na−, and lastly, K-silicates, SiO_2. SiO_2, however, may be formed before K-silicates, generally it appears simultaneously with the alkali-felspar. The glassy base in the acid and basic rocks possesses almost the same percentage of silica as the rock in which it occurs; in the intermediate rocks it is more acid than the rock itself. In the very acid rocks it is more basic, in the very basic rocks more acid than the rock taken as a whole.

The author points out that there appears to be a connection between the order of separation and the specific heat of minerals. Experiments on the specific heat of rock-forming minerals have, however, been too few to warrant any confident generalisation.

He concludes by offering some criticisms on the recent classification of rocks proposed by Rosenbusch, and states that the giving up of geological age as a principal factor in rock-classification is to him a joyful innovation *(eine erfreuliche Neuerung)*, a sentiment which British petrographers will cordially reciprocate. J. J. H. T.

Beiträge zur Kenntniss der Nosean-führenden Auswürflinge des Laacher See's. Von Lucius L. Hubbard. *Tscher. Min. Mitth.* Band VIII. Heft 5.

The ejected blocks of the volcanic district of the Laacher See comprise:—

(1) Crystalline schists.

(2) Sanidinite, consisting entirely or principally of sanidine.

(3) The so-called Laacher trachyte of von Dechen.

(4) Basalt-bombs.

The blocks of sanidinite and Laacher-trachyte occur of all sizes up to masses measuring two feet in diameter. They may be round, oval, or angular. The sanidinite consists principally of sanidine, or of sanidine and nosean. The accessory constituents are plagioclase, magnetite, mica, titanite, zircon, nepheline, scapolite, melanite, orthite, and other rare minerals. The rock may be solid throughout or cavernous. The cavities contain fine crystals of magnetite, titanite, nosean, hornblende, mica, orthite, apatite, &c.

The Laacher-trachyte is light or dark grey, often almost black. It is usually porous. In chemical composition it stands between sanidinite and basalt. It contains crystals of sanidine, plagioclase, augite, mica, olivine, titanite, magnetite, hornblende, and zircon, in a lava-like groundmass. A special variety of rock which must be classed with the sanidinites shows a gneissose or banded structure. After referring to the theories that have been proposed to account for these peculiar ejected blocks, the author proceeds to consider the characters of the more important and interesting minerals which occur in the sanidinite and Laacher-trachyte.

Hauyne (*Nosean*).—The author remarks on the difficulty of distinguishing hauyne from nosean in the absence of the blue colour which often characterises the former. In his descriptions he applies the term nosean to all those minerals of the hauyne-nosean group which are not blue. In this sense nosean is one of the most characteristic minerals of the sanidinites and trachytes. It is well crystallised in the druses, and generally occurs in the form {110} or in the combination {110} and {100}. Hauyne is much less common. Granular nosean is often met with associated with sanidine and other minerals, or occurring by itself in vein-like masses. Both hauyne and nosean show a characteristic greasy lustre.

The colour is variable, not only in different individuals but in different portions of the same individual. Very often the kernel is dark and the

border light, or *vice versa*. Under the microscope the nosean often shows a cloudy appearance, due to extremely minute gas inclusions. These inclusions may be distributed through the section without order, or they may be arranged in straight lines corresponding to the traces of faces of the tesseral system, thus producing a zonal structure. The external zone of an individual is usually remarkably free from inclusions of all kinds, in which respect the noseans of the ejected blocks differ from those of the leucitophyres of Rieden and Olbrück. In addition to the minute gas inclusions above referred to and a few liquid cavities, there occur also small opaque rods and plates which the author regards as magnetite. In the fresh condition these show a metallic lustre; when altered, as is frequently the case, they are yellow or red and without the metallic lustre. The rods have a breadth of about ·0025 mm., the plates measure about ·03 mm. across. Where both rods and plates occur together the former are about as long as the latter are broad. This points to the conclusion that the rods are merely cross-sections of the plates.

The nosean frequently shows traces of having been affected by heat subsequent to its formation, and has often been partially melted. In one case it was represented by a clear green glass in which perlitic cracks were observed.

Orthoclase, Sanidine.—Sanidine occurs in tables with conspicuous development of the clinopinacoid {010}, and also as rectangular prisms showing the forms {001} and {010}. Carlsbad twins are not uncommon, and in one case the face of composition was (100). Doelter and Hussak have shown that felspars may be rendered granular by the action of molten magmas. The sanidine of the ejected blocks sometimes shows a similar granulation. In some cases the original crystals have been broken up, and the parts more or less separated from each other. When this is the case the rocks contain more or less groundmass, which sometimes consists of a clear glass in which new felspar has been generated. A variety of Laacher-trachyte was found to consist of sanidine and a dark grey substance having the aspect of lava. The sanidine in this rock has been both corroded and broken, whereas the other minerals, augite, titanite, and magnetite, have been but little modified. These facts indicate that the rock, as now seen, is the result of the action of a lava-magma upon an original mass of sanidinite. In this rock and in the normal Laacher-trachyte the original sanidinite is fringed with what may be termed secondary sanidine. Small microlites of the secondary sanidine occurring singly or grouped in bundles or spherulites, may also be observed in a

glassy groundmass containing large broken and rounded crystals of the original sanidine.

In the nosean-sanidine rocks the sanidine occurs not only in more or less broken and rounded crystals, but also in aggregates which, in a certain sense, remind one of spherulites. The individuals of these aggregates group themselves in a more or less radial manner. They are distinct from the larger rounded or broken crystals, and must be regarded as of later date. Their composition is as follows :—

SiO_2	65·365
Al_2O_3	21·190
Fe_2O_3	0·446
CaO	0·563
MgO	tr.
Na_2O	6·766
K_2O	5·724
	100·054

The nosean is, as a rule, younger than the original sanidine, but it may be either younger or older than the secondary sanidine. The author divides the nosean-bearing rocks which occur as ejected blocks into four groups :—

(1) The so-called Laacher-trachyte and transitional forms.

(2) Rocks consisting of older sanidine, and which may contain also a granulated sanidine or orthoclase.

(3) Rocks characterised by the presence of nosean and radial aggregates of secondary sanidine in considerable quantity. These may also contain older sanidine.

For rocks of the third type the author proposes the term noseanite.

Plagioclase. This mineral occurs frequently, but is rarely found in well-formed crystals. Many blocks consist almost entirely of plagioclase but the mineral is present only in very subordinate quantity in the noseanite. It occurs generally in forms giving lath-shaped sections or else in small grains, and is often intergrown with orthoclase.

Olivine.—This mineral has not been recognised in the microscopic sections of the nosean-bearing blocks, but it has occasionally been detected by microscopic examination.

Titanite.—This mineral occurs abundantly as well-formed crystals, and as rounded or angular grains, both in the sanidinite and Laacher-trachyte.

The broken and rounded aspect of many of the titanite grains point to the conclusion that the mineral belongs to the earliest period of crystal formation.

Zircon.—This mineral occurs as rounded grains in the rock-masses, and as well-formed crystals with terminations in the druses. The crystals occur generally as long columns, showing the forms {110} and {111}; sometimes also a steeper pyramid. Colourless zircon of pyramidal form is associated with the mineral to be described next. Zircon occurs in melanite, nepheline, sanidine and magnetite.

Azor-pyrrhite.—Under this name the author refers to certain small orange-yellow or dark-red crystals, which are frequently found associated with titanite and nosean. They occur as a rule in regular octahedra; twice, however, the author recognised the combination {111} and {110}. They are perfectly isotropic. The specific gravity lies between 4·1 and 4·3; the hardness is 5·5-6; the fine powder is soluble in hot concentrated sulphuric acid. This mineral was regarded by Wolf as a red spinel. It differs from spinel, however, in hardness, and in the fact that it is soluble in concentrated sulphuric acid. The author regards it as identical with the Pyrrhite of San Miguel, described by Schrauf. In the Laacher See blocks this mineral is associated with a somewhat peculiar form of zircon, in which the pyramidal faces are largely developed, and those of the prismatic zone representing the forms {110} and {100} only feebly developed. This zircon is precisely similar in crystallographic and optical characters to the so-called azorite of San Miguel, the hardness of which, according to the author, is 6·5-7, and not 5-6, as given by Schrauf.

Nepheline.—This is a rare mineral in the ejected blocks. It was observed only four times. In one case it occurred as grains in noseanite, associated with sanidine, zircon, magnetite, augite, scapolite, and much mica. In another case azor-pyrrhite was observed in addition to the above minerals, and the nepheline occurred in part in well-formed crystals, showing the prism, base and pyramid.

Scapolite.—Three cases of the occurrence of scapolite were observed. In one case the associated minerals were orthoclase, nosean, zircon, magnetite, titanite and mica; in the second, orthoclase, zircon, magnetite, mica, augite and nepheline; in the third, orthoclase, nosean, zircon, magnetite, azor-pyrrhite and nepheline.

In thin section the mineral occurs as irregular grains or long columns

without straight boundaries; but in the drusy cavities it may be found in well-formed crystals. It contains, as inclusions, zircon, azor-pyrrhite, glass and relics of nosean and sanidine. J. J. H. T.

Untersuchung von Eläolithsyeniten von der Serra de Tinguá, Brasilien. *Von* Franz Fr. Graeff. *Neues Jahrbuch*, 1887, Band II.

This paper deals with the petrographical characters of the rocks whose geological relations are described by Mr. O. A. Derby in the *Quarterly Journal of the Geological Society*, Vol. XLIII. (1887), p. 457.

For the purposes of description the author divides the rocks into three groups:—

(1) The holocrystalline granular rocks in which hornblende is the dominant ferro-magnesian constituent.

(2) The holocrystalline granular rocks in which ægirite is the dominant ferro-magnesian constituent.

(3) The porphyritic rocks of phonolitic habit, which the author terms elæolite-syenite porphyry.

The rocks of the first group contain orthoclase, elæolite, sodalite, analcime, hornblende, pyroxene, mica, titanite, iron-ores, apatite, zircon, fluorite, and a black mineral possessing a conchoidal fracture or resinous lustre, which the author regards as probably belonging to the garnet group.

The felspar is a normal orthoclase. It rarely occurs in grains of equal dimensions in the different directions; but is almost always more or less lath-shaped (leistenförmig), tabular or columnar. The face M is, however, never very largely developed. The dimensions of the individuals vary in one and the same mass. The larger crystals form somewhat short columns; the smaller are more lath-shaped [? in section]. The smaller crystals possess a glassy lustre,[1] whereas the larger ones often show a feeble waxy lustre and pearl-grey colour.

In addition to the two ordinary cleavages the orthoclase possesses a tendency to separate parallel to $(70\bar{1})$. In cleavage flakes parallel to M this plane makes an angle of 73°, with the cleavage parallel to P. The optic axial angle in air is about 90°. The plane of the optic axes is normal to M, the bisectrix is negative, and the dispersion horizontal $\rho > \nu$. The elæolite-syenites of other localities often contain microcline, plagioclase,

[1] It will be observed that the author applies the term orthoclase to felspars having the physical characters of sanidine. He is probably influenced by the fact that the rocks are of pre-tertiary age.

soda-orthoclase or anorthoclase. The occurrence of normal orthoclase in the Brazilian rocks to the almost entire exclusion of the other varieties is a feature of interest. The composition of the mineral is represented by the following analysis made in the laboratory of Fresenius :—

SiO_2	...	63·52 per cent.
Al_2O_3	...	19·21 ,,
Fe_2O_3	...	0·56 ,,
MgO	...	0·10 ,,
CaO	...	0·63 ,,
Na_2O	...	3·08 ,,
K_2O	...	12·89 ,,
		99·99 per cent.

The single exception to the rule that the felspar is normal orthoclase occurs in a specimen which shows the contact of a phonolitic dyke with the granular elæolite-syenite. The felspar in the syenite here shows a very fine striation, which is especially noticeable under crossed nicols. This striation is probably indicative of a fine micro-perthitic intergrowth of two felspars.

The elæolite is almost as abundant as the orthoclase. It possesses a Sp. Gr. of 2·592, and sometimes occurs in idiomorphic crystals which only show a slight rounding of the edges and angles. It contains fluid inclusions which often constitute negative crystals. Cancrinite, analcime, arise by alteration of the nepheline.

Definitely recognisable sodalite is not very abundant. Well-formed crystals may be sometimes seen enclosed in the felspar.

Analcime occurs as a secondary constituent after both nepheline and sodalite. The author recommends the following as a means of distinguishing between sodalite and analcime. Uncover the slide and remove the canada balsam. Place a drop of very dilute nitric acid (free from chlorine) or acetic acid on the mineral to be tested, and allow it to act for a short time, say a few seconds; then add a drop of a dilute solution of lead nitrate or lead acetate and place the section under the microscope. If sodalite be present long flat needles of lead chloride will be seen to form.

The hornblende is only seen to be transparent in brown or greenish-brown colours when the sections are very thin. It is idiomorphic in the prismatic zone, and often twinned according to the ordinary law. The extinction as observed in cleavage flakes is 13°-16°. Pleochroism and absorption are strong : γ (nearly) $= \beta > \alpha$; γ, greenish brown ; β, dark

brown ; a, light greenish brown. Alumina, magnesia, and alkalies were detected by micro-chemical tests.

Pyroxene is present only in very small quantity in rocks of the present group, and is often absent altogether. It is without definite form. Sections at right angles to the vertical axis are greenish yellow when viewed with rays vibrating parallel to the optic axial plane, and a peculiar reddish grey when viewed with rays vibrating at right angles to this plane. The mineral gives a higher extinction in the prismatic zone than ægirite, and possesses a very strong dispersion $\rho > \nu$.

The dominant mica is dark brown and strongly pleochroic, with a very small optic axial angle. It never occurs in well-formed crystals. A second variety, having a sap-green or olive-green colour, sometimes occurs. It often shows well-defined six-sided outlines. Titanite is present, and occurs both in well-formed crystals and as grains.

The dominant type of rock is formed principally of orthoclase and elæolite, and the former is generally somewhat in excess of the latter. These two constituents determine the general aspect of the rock as regards colour and size of grain, the other constituents being completely subordinate to them. The structure of the rock is granitic; its specific gravity is 2·566. As already stated, hornblende is the dominant ferro-magnesian constituent. This is an interesting point, because hornblende is turning out to be a somewhat rarer mineral in the elæolite-syenites than was formerly supposed. The constituents of the rocks often show the effects of mechanical deformation and chemical corrosion. As an illustration of the latter, the opacite-border, which almost always surrounds the hornblende, may be especially mentioned.

Small veins, at most only 2 mm. broad, often traverse the rock above described. These are poorer in the ferro-magnesian constituents, and richer in felspar, elæolite, and accessory minerals, such as garnet, fluorite, orthite (?) and laavenite, than the main mass of the rock. The grain of the rock forming these veins is less coarse than that of the rock, and the felspars are markedly lath-shaped.

The rock with striated felspar must be regarded as a special type of the first group. It differs from the normal type not only in the character of its felspar, but also in the fact that augite is as abundant as hornblende. Mica is present in considerable quantity, and is usually much decomposed. Cancrinite has been developed at the expense of elæolite. It occurs as long irregularly bounded rods, which are always similarly orientated in the same individual. Titanite occurs only in the form of colourless grains, and is associated with ilmenite and calcite. The ilmenite shows some-

times very sharp boundaries. Tourmaline and cassiterite occur as accessory minerals in the rock now under consideration.

We pass now to the second group of rocks. These are similar to the former in structure, but they contain ægirite instead of hornblende. Fluorite is fairly abundant, and also two of the rarer minerals—laavenite and rinkite. The ordinary minerals are similar to those already described. The ægirite is green by transmitted light, strongly pleochroic and idiomorphic in the prismatic zone. The laavenite occurs as small honey-yellow crystalline grains, and appears to be regularly distributed throughout the rock. In examining hand specimens it is scarcely recognisable, and may be easily confused with titanite. It is characterised by strong refractive and double-refractive power; thus it gives the white of the higher orders even in thin sections. It sinks in a solution having the specific gravity 3·526. It dissolves in fused acid potassium sulphate, and the solution in water gives with H_2O_2 the reaction for titanium. Sodium (abundant), calcium, magnesium, manganese and iron were proved by micro-chemical tests. The mineral is monoclinic, with a cleavage parallel to the orthopinacoid. The optic axial plane lies parallel with the clino-pinacoid, and $a = \gamma$, $b = \beta$ and $c = \alpha$. The mineral is strongly pleochroic; β, dark yellow; α, light yellow or colourless.

The crystallographic characters were determined by goniometric measurements on some fairly well-formed crystals which were found amongst the grains isolated by means of heavy solutions.

The second accessory mineral is somewhat more abundant than laavenite. The most common sections are bounded by two sides which lie parallel to the direction of elongation. There is a perfect cleavage parallel to the direction of elongation. The refractive power is high, but the double-refraction is low, the common tints in thin sections corresponding to the yellow-orange of the first order. The extinction is either parallel to the cleavage or deviates from it only by a few degrees. The major axis of depolarisation lies parallel with the cleavage. The plane of the optic axes lies at right angles to the cleavage, or nearly so. The mineral is pleochroic; colourless for rays vibrating parallel to the cleavage, and light yellow for rays vibrating at right angles to the cleavage. The sections described above are attacked by concentrated HCl with separation of gelatinous silica. The mineral is frequently associated with laavenite and fluorite. The author has compared this mineral with the rinkite of Steenstrup and Lorenzen, and believes it to be the same.

The geological relations of the ægirite-bearing rocks are not known as the specimens examined were all from boulders in the Rio de Curo.

The rocks of the third group occur as dykes, and are characterised by their porphyritic structure. A typical specimen consists of a compact green groundmass containing white porphyritic constituents. The groundmass is a fine-grained granular aggregate of orthoclase, elæolite, and ægirite. Its specific gravity is 2·628; that of the entire rock is 2·616. The porphyritic constituents are orthoclase in somewhat tabular crystals, elæolite in well-formed crystals, and having all the characters of nepheline, sodalite, and more rarely augite. Magnetite and titanite are also mentioned in this connection. Besides the above minerals the groundmass encloses polygonal patches of elæolite-syenite precisely similar to the rock in which the dyke occurs. These patches are fairly uniform in size, and somewhat less than an inch across. The sections of these patches are bounded by straight lines which meet in sharp angles, so that at the first glance one is strongly inclined to regard the patches as porphyritic crystals. Apart from their peculiar external form they have the structure and composition of the neighbouring elæolite-syenite.

The author differentiates these rocks from the true phonolites which they so closely resemble by the character of their groundmass. This, he says, possesses the hypidiomorphic granular structure of plutonic rocks, and not the panidiomorphic granular structures of the normal phonolites.

The petrographical work was done in the laboratory of Prof. Rosenbusch.

J. J. H. T.

Andalusit-führende Granite. Von E. Cohen. *Neues Jahrbuch*, Band II. 1887, p. 178.

The author describes the occurrence of a mineral resembling andalusite in certain granites from the Vosges and the Black Forest. The same mineral is abundant in a tourmaline-granite from Alt-Zschillen, near Wechselburg in Saxony. It occurs as long or short columns, which always lie isolated from each other, never grouped as in contact-rocks and crystalline-schists. The terminations are most frequently irregular, fringed or ruin-like. A roof-like ending, however, not unfrequently occurs. The longitudinal sections give straight extinction. Cross sections show that the prism is nearly rectangular, and that extinction takes place parallel with the diagonals. The greatest axis of elasticity always lies parallel with the length of the crystal $c = a$. All crystals show pleochroism. Rays vibrating parallel to c are light or dark red, the intensity varying considerably in one and the same individual. Rays vibrating parallel to

a and *b* are colourless, or nearly so. Specific gravity lies between 3·05 and 3·15. The above facts prove the mineral to be andalusite. It thus appears that Professor Cohen and the present writer[1] have simultaneously recorded the occurrence of andalusite as an original constituent of certain granites. J. J. H. T.

Origin of the Ferruginous Schists and Iron-ores of the Lake Superior Region. By R. D. Irving. *American Jour. Sci.* Vol. XXXII. October 1886.

The iron-ores of this region (magnetite and hematite) occur in association with jaspery and cherty rocks. There has been considerable difference of opinion amongst previous writers as to the origin of these ores and their associated rocks; some referring them to a sedimentary, others to an eruptive origin. The geological surveyors in the course of their investigations have recognised the existence of carbonate-bearing beds in the iron-bearing regions, and have been led to regard the jaspery and cherty schists and the iron-ores as the result of the alteration and silification of beds of carbonates. In some localities an actual passage of beds rich in carbonates, and especially carbonate of iron, into the ferruginous rocks may be observed. The transformation of the original rocks has sometimes been accompanied by the development of actinolite and garnet. The general conclusion has been confirmed by the study of a large series of microscopic slides. The carbonates when present are always seen to be the oldest minerals in the rocks.[2] J. J. H. T.

Artificial Production of Quartz and Tridymite.—M. K. de Kroustchoff has produced finely crystallised quartz by heating a solution of silica in

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[1] *Min. Mag.* Vol. VII. (1887), p. 161. This paper was read on May 10th, 1887, and Professor Cohen's letter to the Editor of the *Neues Jahrbuch* is dated May 1887.—J. J. H. T.

[2] The fact that silica will replace carbonate of lime is of course well known, and has been illustrated experimentally by Professor Church, who allowed a 1 p. c. solution of silicic hydrate to drop on to a coral, and found that silica was retained and carbonate of lime removed. It would be interesting to repeat Professor Church's experiments with carbonate of iron. If, as seems highly probable, a similar reaction should take place, iron oxides would be precipitated wherever the conditions were favourable to oxidation, and an association of silica and iron-oxides such as that which occurs in the Lake Superior Region would be produced. In connection with the association of amorphous silica and iron-ores, the following fact may be mentioned. If a portion of the oolitic Cleveland ore be treated with hydrochloric acid, hollow shells (like egg-shells) of silica, resembling the oolitic grains in form and size, will remain behind. These shells are readily dissolved in caustic potash. That the silica of which they are composed has been introduced in connection with the metamorphic processes to which the rock has been subjected, is proved by the fact that similar shells are not left after treating an ordinary oolitic limestone in the same way.—J. J. H. T.

pure water in a closed vessel, and maintaining it at a temperature of 250° C. for several months. He has also produced tridymite by the following two methods :—(1) Fragments of rocks rich in quartz were submitted to the action of a fused basalt or melaphyr for 1 to 6 hours. (2) Fragments of rocks rich in quartz were partially or completely fused. In these experiments the quartz is seen to break up into angular fragments, and to dissolve in the magma, either direc'ly without further change, or after being transformed into a finely fibrous mass exhibiting aggregate polarisation, which is absorbed by the magma as by a sponge. This substance then breaks up into segments with rectilinear boundaries and completely isotropic, but at the centres of the segments brilliant particles of unaltered quartz may often be detected under crossed nicols. To this succeeds a process of complete alteration, in which the quartz is converted into a scaly mass of tridymite; these scales have the character sometimes of uniaxial and sometimes of biaxial crystals. *Bull. Soc. Min.* X. 1887, pp. 31-6, and *Neues Jahrb.* 1887 (1) pp. 205-8. H. A. M.

Twin-crystals of Garnet. (*Verh. d. Russisch. Kais. Mineralog. Ges.* 32 (1887), p. 126.) Crystals of garnet from Pitkäranta are described by A. Arzruni, which are remarkable, both as being the only known case of twinned garnet, and also as affording examples of a new twin law in the cubic system. The crystals are a combination of the dodecahedon {110} with the icositetrahedron {211}, and are twinned upon a face of the tetrakishexadron {210}. H. A. M.

Garnet from Breslau. (*Verhandl. d. k. k. geolog. Reichsantalt* 1886, p. 328.) In digging the foundations of the Theological College at Breslau, the workmen found a large number of brown garnet crystals embedded in a dark grey sand, about 10 metres from the Oder. Examination of this nest of garnets has shown that they must have been originally enclosed in a white crystalline limestone; the only other mineral which could be detected with certainty was green augite in small grains.

The crystals were found at a depth of only two metres from the surface, but many thousands were collected. Dr. Roemer believes that they were not placed in this spot by human agency; they cannot have been transported by the Oder, which at Breslau has a slow current and only carries fine sand; and the only other explanation which he suggests is that they may have been derived from a block of limestone transported by glacial action. H. A. M.

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W. Voigt. Nachr. Ges. Wiss. Gött. 1886, pp. 93, 289. *Elasticity.*
A. Purgold. Isis (Ber.), 1885, p. 33. *Salzburg Alps.*
A. Damour. Bull. Soc. Min. ix. p. 153. *Madagascar, Chem.*
S. Penfield and D. Harper. Chem. News, liv. p. 91. *Chem.;* and Am. J. Sc. xxxii. p. 107.
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F. Sandberger. N. J. 1886 (1), p. 90. *S. America.*

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E. Dana. Am. J. Sc. xxxi. p. 314. *Arkansas, Cryst.*

BROCHANTITE. J. Cooper. Bull. Washb. Lab. i. p. 170. *Arizona.*

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G. Cesaro. Bull. Soc. Min. ix. p. 242. *Cryst.*

A. Griffiths and S. Dreyfus. Chem. News, liv. p. 67. *Siberia, Chem.*

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A. Purgold. Isis. (Ber.) 1885, p. 31. *Hüttenberg.*

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D. Lovisato. Alt. Ac. Linc. Rend. ii. p. 257. *Sardinia.*

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CARINTHIA. A. Brunlechner. Jahrb. L. Mus. Kärnt. xviii. p. 74. *Min. of.*

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Coals.	A. Taylor. Min. Mag. vii. p. 13. *Nomenclature.*
Coccolite.	A. Cathrein. Zs. K. xii. p. 34. *Viezena.*
Colemanite.	A. Jackson. Bull. Cal. Ac. Sc. i. p. 358. *Cryst.*
Columbite.	E. Dana. Am. J. Sc. xxxii. p. 386. *Cryst.;* and Zs. K. xii. p. 266.
Copper.	E. Dana. Am. J. Sc. xxxii. p. 413. *Cryst.*
Copper Pyrites.	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 192. *Bolivia.*
	Oppermann. Ann. Min. x. p. 444. *Chem.*
	H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 345. *Chem.*

COPPER ORE. H. Becher. Q. J. Geol. Soc. xlii. p. 494. *China.*
Béchevel. Ann. Min. x. p. 433. *Chem.*
Nentien. Ann. Min. x. p. 461. *Chem.*
Sergère. Ann. Min. x. p. 476. *Chem.*
COQUIMBITE. F. Sandberger. N. J. 1886 (1), p. 178. *Chili.*
CORDIERITE. E. Scacchi. Att. Ac. Linc. Rend. ii. p. 183. *Tuscany.*
J. Joly. Proc. Roy. Dub. Soc. v. p. 48. *Glencullen.*
CORUNDUM. O. Mügge. N. J. 1886 (1), p. 146. *Twinning.*
B. v. Camerlander. Verh. Geol. Reichs. 1886, p. 256. *Silesia.*
COUSERANITE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*
CRISTOBALITE. G. v. Rath. Verh. Nat. Ver. Rheinl. xxxiv. corr. bl. p. 121 *New Min.*
CROCOISITE. F. Sandberger. N. J. 1886 (1), p. 90. *S. America.*
CRYOLITE. F. Oettel. Isis. (Ber.) 1885, p. 29. *Art.*
CRONSTEDTITE. H. v. Foullon. Verh. Geol. Reichs. 1886, p. 468. *Kuttenberg.*
CRYSTALS. H. Vater. Zs. K. xi. p. 549. *Elasticity.*
J. Lehmann. Zs. K. xi. p. 608. *Contraction-cracks.*
W. Ramsay. Zs K. xii. p. 209. *Refract. Index.*
O. Lehmann. Zs. K. xii. p. 377. *Growth of, &c.*
J. Beckenkamp. Zs. K. xii. p. 419. *Elasticity of.*
B. Minnigerode. N. J. 1886 (1), p. 7. *Therm. Math.*
T. Liebisch. N. J. 1886 (1), pp. 14, 155. *Opt. Math.*
O. Mügge. N. J. 1886 (1), p. 136. *Secondary twinning.*
P. Volkmann. N. J. 1886 (1), p. 205. *Reflexion, Math.*
A. Schrauf. N. J. 1886 (1), p. 234. *Morphotropy, &c.*
T. Liebisch. N. J. 1886 (2), p. 47. *Reflexion.*
J. Danker. N. J. Beil. Bd. iv. p. 241. *Reflexion.*
K. Schmidt. Pogg. xxix. p. 451. *Reflexion.*
W. Voigt. Pogg. xxix. p. 604. *Torsion.*
E. Ketteler. Pogg. xxviii. pp. 230, 520. *Reflexion.*
A. Schrauf. Pogg. xxviii. p. 433. *Therm. Opt.*
E. Mallard. Bull. Soc. Min. ix. p. 54. *Opt. anomalies.*
G. Wyrouboff. Bull. Soc. Min. ix. p. 102. *Isomorphism.*
E. Mallard. Bull. Soc. Min. ix. p. 115. *Isomorphism.*
E. Mallard. Bull. Soc. Min. ix. p. 154. *Reflexion.*
G. Cesaro. Bull. Soc. Min. ix. p. 222. *Twinning.*
G. Wyrouboff. Ann. Chim. Phys. viii. p. 340. *Circular Pol.*
E. Ferron. Publ. Inst. Lux. xx. pp. 1, 49. *Opt. Math.*
C. d'Huart. Publ. Inst. Lux. xx. p. 61. *Opt. Math.*
T. Kjerulf. Forh. Vid. Sels. Christ. 1885, 16. *Opt. Sign.*
W. Barlow. Chem. News, liii. pp. 3, 16. *Symmetry;* and Rep. Brit. Ass. 1885, p. 983.
CRYSTALLOGRAPHY. B. Hecht. Zs. K. xi. p. 531. *Math.*
A. Schrauf. Zs. K. xii. p. 175. *Math.*
R. Prendel. Zs. K. xii. p. 460. *Hemihedrism.*
H. Miers. Zs. K. xii. p. 462. *Math.*
C. Brown. Proc. Roy. Soc. Ed. xiii. p. 118. *Hexag. System.*
CUPRO-URANITE. F. Sandberger. N. J. 1886 (1), p. 250. *Fichtelgebirge.*

CYANITE. M. Websky. Zts. Geol. Ges. xxxviii. p. 473. *Georgia.*

DANBURITE. M. Schuster. Min. Mag. vi. p. 213. *Cryst.*

DATOLITE. R. Riechelmann. Zs. K. xii. p. 436. *Seisser Alp, Cryst.*

L. Bombicci. Mem. Ac. Bol. vii. p. 101. *Cryst.;* and Rendic. Ac. Bol. 1886, p. 42.

DAVREUXITE. A. Lacroix. C. R. cii. p. 273. *Opt.;* and Bull. Soc. Min. ix. p. 5.

DESCLOIZITE. A. Des Cloizeaux. Zs. K. xii. p. 178. *Cryst. Opt.;* and Bull. Soc. Min. ix. p. 138.

DESMINE. L. Langemann. N. J. 1886 (2), p. 126. *Mon.*

DIAMOND. A. Schrauf. N. J. 1886 (1), p. 93. *Opt.*

N. Chatrian. Bull. Soc. Min. ix. p. 302. *Salobro, Min.*

DIASPORE. E. Dana. Am. J. Sc. xxxii. p. 388. *Cryst.;* and Zs. K. xii. p. 459.

DIOPSIDE. J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*

G. Flink. Zs. K. xi. p. 449. *Nordmark, Cryst. &c.*

J. Götz. Zs. K. xi. p. 236. *Cryst.*

G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 222. *De Kalb, Cryst.*

O. Mügge. N. J. 1886 (1), p. 185. *Art. twinning.*

DIPYRE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

DOGNACSKA. vid. Moravica.

DOLOMITE. J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*

J. Danker. N. J. Beil. Bd. iv. p. 285. *Opt.*

H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 347. *Chem.*

DUBLIN. W. O'Neill. Sci. Goss. xxii. p. 205. *Min. of.*

ELAEOLITE. F. Sandberger. N. J. 1886 (1), p. 89. *Caracoles.*

EMBOLITE. J. Munro. Chem. News, liii. p. 99. *Victoria, Chem.*

J. Welch. Chem. News, liv. pp. 94, 162. *Chem.*

ENDLICHITE. F. Genth and G. v. Rath. Chem. News, liii. p. 218. *Lake Valley.*

ENHYDROS. Nies. Jahresb. Ver. Württ. xlii. p. 57.

EPIDOTE. J. Götz. N. J. Beil. Bd. iv. p. 127. *Transvaal, Chem.*

EPSOMITE. E. Priwosznik. Berg. u. Hütt. Jahrb. 1886, 3. *Min.*

ERZGEBIRGE. F. Scalch. N. J. Beil. Bd. iv. p. 178. *Min. of.*

ESTLAND. vid. Kurland.

EUCLASE. R. Köchlin. Ann. Mus. Wien. i. p. 237. *Austria.*

A. Purgold. Isis (Ber). 1885, p. 32. *Glockner.*

EUDIALYTE. C. Rammelsberg. Zts. Geol. Ges. xxxviii. p. 497. *Chem* and Ber. Ak. Berl. 1886, p. 441.

FELSPAR. J. Judd. Q. J. Geol. Soc. xlii. p. 64. *Mull, Chem.*

H. Miers. Min. Mag. vii. p. 10. *Kilima-njaro.*

J. Siemiradzki. N. J. Beil. Bd. iv. p. 209. *Ecuador, Chem*

O. Mügge. N. J. Beil. Bd. iv. p. 591. *Masai-land.*

FELSPAR. E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 3. *Stainz.*
R. Bréon. C. R. ciii. p. 170. *Anorthic, Min.*
FLUOR. W. Voigt. N. J. Beil. Bd. iv. p. 228. *Elasticity.*
R. Solly. Min. Mag. vi. p. 202. *Callington.*
J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*
FORSTERITE. B. Mierisch. Min. Mitth. viii. p. 139. *Vesuvius.*
G. Strüver. Att. Ac. Linc. Rend. ii. p. 459. *Baccano, Cryst.*
GADOLINITE. W. Crookes. Proc. Roy. Soc. xl. p. 502. *Chem;* and Chem. News, liv. p. 13.
L. Eakins. Chem. News, liii. p. 282. *Chem.*
F. Eichstädt. Bih. Vet. Ak. Hand. x. 18. *Cryst.*
GALENA. Oppermann. Ann. Min. x. p. 443. *Chem.*
Sergère. Ann. Min. x. p. 474. *Chem.*
Nentien. Ann. Min. x. p. 462. *Chem.*
C. Grewingk. Ber. Nat. Ges. Dorp. viii. p. 84. *Livland.*
O. Mügge. N. J. 1886 (1), p. 191. *Art. twinning.*
G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 34. *Mimetite pseud. after.*
H. Foullon. Jahrb. Geol. Reichs. xxxvi. p. 345. *Chem.*
GARNET. A. Cathrein. Zs. K. xii. p. 35. *Canzocoli.*
G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 36. *Salides.*
v. Dechen. Ber. Nied. Ges. Bonn. 1886, p. 261. *Breslau.*
A. Cathrein. N. J. 1886 (1), p. 84. *Oetzthal, Min.*
F. Roemer. Zts. Geol. Ges. xxxviii. p. 723. *Breslau;* and Verh. Geol. Reichs. 1886, p. 403.
A. Sauer. Zts. Geol. Ges. xxxviii. p. 705. *Waldheim.*
C. Klement. Min. Mitth. viii. p. 18. *Chem.*
B. Mierisch. Min. Mitth. viii. p. 143. *Vesuvius.*
F. Gonnard. C. R. ciii. p. 654. *Puy de-Dôme.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 14, 21. *Stainz.*
A. Gehmacher. Ann. Mus. Wien. i. p. 233. *Ekbatana, &c.*
E. Scacchi. Att. Ac. Linc. Rend. ii. p. 182. *Tiriolo.*
R. Solly. Min. Mag. vi. p. 202. *Devonshire.*
W. Cross. Am. J. Sc. xxxi. p. 432. *Nathrop.*
GAYLUSSITE. E. Geinitz. Isis (Ber.) 1885, p. 28. *Art.*
GERSDORFFITE. L. Sipöcz. Zs. K. xi. p. 213. *Chem.*
GIOBERTITE. L. Bourgeois. C. R. ciii. p. 1090. *Art.*
GLAUBERITE. Leuze. Jahresh. Ver. Württ. xlii. p. 65. *Pseud.*
GLAUCOPHANE. K. Oebbeke. Zs. K. xii. p. 282. *Localities;* and Zts. Geol. Ges. xxxviii. p. 634.
T. Bonney. Min. Mag. vii. p. 1. *Val d'Aoste.*
GOETHITE. J. Welch. Chem. News, liii. p. 79. *Chem.*
GOLD. A. Gehmacher. Ann. Mus. Wien. i. p. 233. *Ekbatana, &c.*
E. Dana. Zs. K. xii. p. 275. *Cryst.;* and Am. J. Sc. xxxii. p. 132.
Landsberg. Verh. Nat. Ver. Rheinl. xxxiv. corr. bl. p. 63 *Brazil.*

GOLD, R. Romanis. Chem. News, liv. p. 278. *Burma, Min.*

GRAPHITE. Le Verrier. Ann. Min. x. p. 455. *Chem.*

H. v. Foullon. Jahrb. Geol. Reichs. xxxvi. p. 341. *Chem.*

GREENOCKITE. F. Sandberger. N. J. 1886 (1), p. 251. *Briton and Neu-sinka.*

GRÜNERITE. A. Lacroix. C. R. cii. p. 643, *Opt.*; and Bull. Soc. Min. ix. p. 40.

GUANAJUATO. G. v. Rath. Verh. Nat. Ver. Rheinl. xxxiv. corr. bl. p. 97. *Min. of.*

GUEJARITE. F. Sandberger. N. J. 1886 (1), p. 89. *Bolivia.*

GYPSUM. S. Meunier. C. R. cii. p. 1406. *Min.*

A. Des Cloizeaux. Bull. Soc. Min. ix. p. 175. *Cryst.*

J. Lehmann. Zs. K. xi. p. 611. *Contraction-cracks.*

J. Danker. N. J. Beil. Bd. iv. p. 280. *Opt.*

F. Cragin. Bull. Washb. Lab. i. p. 166. *Kansas.*

Leuze. Jahresh. Ver. Württ. p. 63. *Quartz pseud. after.*

Leuze. Jahresh. Ver. Württ. xlii. p. 66. *Calcite pseud. after.*

HAEMATITE. O. Mügge. N. J. 1886 (2), p. 35. *Secondary twinning.*

F. Schalch. N. J. Beil. Bd. iv. p. 193. *Magnetite pseud. after.*

Leuze. Jahresh. Ver. Württ. xlii. p. 63. *Chalybite pseud. after.*

G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 36. *Durango.*

G. Strüver. Att. Ac. Linc. Rend. ii. (2), p. 331. *Magnetite pseud. after.*

J. Welch. Chem. News, liii. p. 52. *Chem.*

W. Gresley. Mid. Nat. ix. pp. 1, 33, 64, 92. *Nodules.*

E. Geinitz. Isis (Ber.), 1885, p. 29. *Art.*

HALLOYSITE. Oppermann. Ann. Min. x. p. 448. *Chem.*

HARMOTOME. L. Langemann. N. J. 1886 (2), p. 83. *Mon.*

J. Joly. Proc. Roy. Dub. Soc. v. p. 165. *Wicklow.*

HARSTIGITE. W. Ramsay. Zs. K. xii. p. 220. *Refract. Index.*

HAUYNE. B. Mierisch. Min. Mitth. viii. p. 167. *Vesuvius.*

HEMIMORPHITE. F. Schalch. N. J. Beil. Bd. iv. p. 187. *Erzgebirge.*

HERDERITE. A. Purgold. Isis (Ber.), 1885, p. 32. *Stoneham.*

A. Des Cloizeaux. Bull. Soc. Min. ix. p. 141. *Opt.*

S. Penfield and D. Harper. Am. J. Sc. xxxii. p. 107. *Chem.*; and Chem. News, liv. p. 90.

W. Hidden. Am. J. Sc. xxxii. p. 209. *Cryst.*

HEULANDITE. V. Goldschmidt. Ann. Mus. Wien. i. p. 129. *Spec. Grav.*

HORNBLENDE. J. Götz. N. J. Beil. Bd. iv. p. 126. *Transvaal, Chem.*

J. Siemiradzki. N. J. Beil. Bd. iv. p. 209. *Ecuador, Chem.*

K. Oebbeke. Zs. K. xi. p. 368. *Mt. Dore, Cryst.*

B. Mierisch. Min. Mitth. viii. p. 174. *Vesuvius.*

E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 14. *Stainz.*

J. Kloos. N. J. 1886 (1), p. 211. *Chem.*; and Jahresh. Ver. Württ. xlii. p. 321.

HORNSTONE. R. Solly. Min. Mag. vi. p. 203. *Devonshire.*

HUMBOLDTILITE. B. Mierisch. Min. Mitth. viii. p. 149. *Vesuvius.*
C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

HUMITE. B. Mierisch. Min. Mitth. viii. p. 141. *Vesuvius.*
A. Levy and A. Lacroix. Bull. Soc. Min. ix. p. 81. *Opt.*
E. Mallard. Bull. Soc. Min. ix. p. 84. *Cryst.*

HUNGARY. L. Sipöcz. Zs. K. xi. p. 210. *Min. of.*
A. Schmidt. Zs. K. xii. p. 97. *Min. of.*

HYALITE. Leuze. Jahresh. Ver. Württ. xlii. p. 64. *Pseud. after Calcite and Quartz.*

HYDROCERUSSITE. L. Bourgeois. C. R. ciii. p. 1089. *Art.*

HYDRONEPHELITE. F. Clarke. Am. J. Sc. xxxi. p. 265. *Maine, New Min.*

HYDROTEPHROITE. A. Lacroix. C. R. cii. p. 274. *Opt;* and Bull. Soc. Min. ix. p. 6.

HYDROUS ANTHOPHYLLITE. A. Lacroix. C. R. cii. p. 274. *Opt.;* and Bull. Soc. Min. ix. p. 7.

HYPERSTHENE. K. Oebbeke. Zs. K. xi. p. 367. *Mt. Dore, Cryst.*
A. Schmidt. Zs. K. xii. p. 97. *Mt. Pokhausz, Cryst,*
J. Siemiradzki. N. J. Beil. Bd. iv. p. 214. *Ecuador, Chem.*

ICE. A. Kenngott. N. J. 1886 (2), p. 184. *Cryst.*

IDOCRASE. C. Rammelsberg. Zts. Geol. Ges. xxxviii. p. 507. *Chem.*
B. Mierisch. Min. Mitth. viii. p. 137. *Vesuvius.*
W. Lewis. Min. Mag. vii. p. 9. *Zermatt.*
L. Igelström. Bull. Soc. Min. ix. p. 22. *Jacobsberg, Manganif.*

IDRIA. F. Friese. Verh. Geol. Reichs. 1886, p. 431. *Min.*

ILMENITE. A. Cathrein. Zs. K. xii. p. 40. *Growth with Magnetite.*

IODYRITE. F. Genth and G. v. Rath. Chem. News, liii. p. 218. *Lake Valley.*
F. Sandberger. N. J. 1886 (1), p. 89. *Caracoles.*

IRELAND. G. Kinahan. Proc. Roy. Dub. Soc. v. p. 200. *Min. of.*

IRON-ORES. Le Verrier. Ann. Min. x. p. 453. *Chem.*
Nentien. Ann. Min. x. p. 463. *Chem.*
Tingry. Ann. Min. x. p. 466. *Chem.*
Sergère. Ann. Min. x. p. 474. *Chem.*
Poncelet. Ann. Min. x. p. 480. *Chem.*
De Grossouvre. Ann. Min. x. p. 311. *France.*
H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 342. *Chem.*
R. Irving. Am. J. Sc. xxxii. p. 255. *Origin of.*

JADE. J. White. Chem. News, liv. p. 20. *Mogaung, Chem.*

JASPER. R. Solly. Min. Mag. vi. p. 203. *Devonshire.*

JEFFERSONITE? vid. Hornblende. (J. Kloos.)

KALICITE. C. Grewingk. Ber. Nat. Ges. Dorp. viii. p. 50. *Dorpat.*

KALIOPHILITE. B. Mierisch. Min. Mitth. viii. p. 157. *New Min.*

KOBELLITE. H. F. and H. A. Keller. N. J. 1886 (2), p. 79. *New variety.*

KOPPITE.	G. Bailey. J. Chem. Soc. 1886, p. 153. *Chem.*; and Lieb. Ann. ccxxxii. p. 357.
KRENNERITE.	L. Sipöcz. Zs. K. xi. p. 210. *Chem.*; and Ber. Chem. Ges. Berl. xix. p. 96.
KRYPTOLITE.	A. Sauer. Zts. Geol. Ges. xxxviii. p. 705. *New Min.*
KURLAND.	C. Grewingk. Ber. Nat. Ges. Dorp. viii. p. 43. *Min. of.*
LABRADORITE.	V. Goldschmidt. Ann. Mus. Wien. i. p. 129. *Spec. Grav.*
LANGITE.	H. v. Foullon. Verh. Geol. Reichs. 1886, p. 465. *Chem.*
LAUMONTITE.	F. Scalch. N. J. Beil. Bd. iv. p. 184. *Erzgebirge.*
LEADHILLITE.	D. Lovisato. Att. Ac. Linc. Rend. ii. p. 256. *Sardinia.*
LEAD-ORE.	Poncelet. Ann. Min. x. p. 479. *Chem.*
LEPIDOLITE.	F. Clarke. Am. J. Sc. xxxii. p. 353. *Chem.*
	R. Scharizer. Zs. K. xii. p. 1. *Twinning of.*
LEPIDOMELANE.	F. Clarke. Am. J. Sc. xxxi. p. 268. *Maine, Chem.*
LEUCITE.	V. Goldschmidt. Ann. Mus. Wien. i. p. 129. *Spec. Grav.*
	B. Mierisch. Min. Mitth. viii. p. 153. *Vesuvius.*
LIMONITE.	E. Smith. Am. J. Sc. xxxi. p. 376. *Pseud. after Pyrites.*
	J. Meem. Am. J. Sc. xxxii. p. 274. *Pseud. after Pyrites.*
	J. Welch. Chem. News, liii. p. 65. *Chem.*
	Oppermann. Ann. Min. x. p. 445. *Chem.*
LITCHFIELD.	F. Clarke. Am. J. Sc. xxxi. p. 262. *Maine, Min. of.*
LIVLAND.	Vid. Kurland.
LUCASITE.	T. Chatard. Am. J. Sc. xxxii. p. 375. *New Min.*
MAGNETITE.	J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*
	A. Cathrein. Zs. K. xii. p. 37. *Scalotta, Chem.*
	A. Cathrein. Zs. K. xii. p. 40. *Growth with Ilmenite.*
	A. Cathrein. Zs. K. xii. p. 47. *Twinning.*
	F. Hornstein. N. J. 1886 (1), p. 253. *Magnetic.*
	F. Schalch. N. J. Beil. Bd. iv. p. 193. *Pseud. after Haematite.*
	G. Struver. Att. Ac. Linc. Rend. ii. (2), p. 331. *Pseud. after Haematite.*
	Scheibe. Zts. Geol. Ges. xxxviii. p. 469. *Cryst.*
MALACHITE.	F. Sandberger. N. J. 1886 (1), p. 179. *Argentine Rep.*
	L. Bourgeois. C. R. ciii. p. 1090. *Art.*
MANGAN-APATITE.	F. Sandberger. N. J. 1886 (1), p. 89. *Saxony.*
MANGANESE-ORES.	H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 344. *Chem.*
	Le Verrier. Ann. Min. x. p. 453. *Chem.*
	Nentien. Ann. Min. x. p. 463. *Chem.*
	Sergère. Ann. Min. x. p. 474. *Chem.*
	Götting. B. H. Ztg. xlv. p. 345. *Bosnia, Min.*
MANGANITE.	R. Brauns. N. J. 1886 (1), p. 252. *Oberstein.*
MANGANOSTIBIITE.	A. Kenngott. N. J. 1886 (2), p. 185. *Chem.*
MARCASITE.	E. Palla. Verh. Geol. Reichs. 1886, p. 266. *Marienbad.*
	C. Grewingk. Ber. Nat. Ges. Dorp. viii. p. 83. *Estland.*

MARIALITE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

MARTITE. F. Schalch. N. J. Beil. Bd. iv. p. 189. *Rittersgrün.*

MEIONITE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

B. Mierisch. Min. Mitth. viii. p. 148. *Vesuvius.*

MELILITE. B. Mierisch. Min. Mitth. viii. p. 152. *Vesuvius.*

MICA. K. Oebbecke. Zs. K. xi. p. 257. *Meran.*

J. Lehmann. Zs. K. xi. p. 611. *Contraction-cracks.*

R. Scharizer. Zs. K. xii. p. 11. *Regular growths of.*

R. Scharizer. Zs. K. xii. p. 15. *Schüttenhofen, Chem.*

B. Mierisch. Min. Mitth. viii. p. 132. *Vesuvius.*

E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 12, 21. *Stainz.*

J. Woldrich. Verh. Geol. Reichs. 1886, p. 455. *Bohemia.*

MICROCLINE. K. Oebbeke. Zs. K. xi. p. 256. *Meran.*

E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 6. *Stainz.*

MICROLITE. F. Feist. Zs. K. xi. p. 255. *Virginia, Cryst.*

MICROSOMMITE. B. Mierisch. Min. Mitth. viii. p. 161. *Vesuvius.*

MILARITE. W. Ramsay. Öfv. Vet. Ak. Förh. 1885, 9, p. 29. *Cryst. Opt.*

MIMETITE. P. Jeremejew. Verh. Russ. Min. Ges. xxii. p. 179. *Nertschinsk.*

G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 36. *Pseud. after Galena.*

MINERALS. V. Goldschmidt. Ann. Mus. Wien. i. p. 127. *Spec. Grav.;* and Verh. Geol. Reichs. 1886, p. 439.

P. Oberg. Öfv. Vet. Ak. Förh. 1885, 8, p. 43. *Spec. Heat.*

J. Joly. Proc. Roy. Dub. Soc. v. p. 41. *Spec. Grav.*

J. Joly. Chem. News, liv. p. 279. *Spec. Heat.*

J. Thoulet. Rev. Sci. xxxvii. p. 136. *Biology of.*

J. Kerr. Min. Mag. vii. p. 18. *Formulæ of.*

R. Brauns. N. J. 1886 (2), p. 72. *Separation, &c.*

T. Behrens. Chem. News, liv. pp. 196-316. *Microchemical.*

T. Hunt. Can. Rec. ii. p. 116. *Classification.*

MINERAL VEINS. A. v. Groddeck. Rev. d. Min. xix. p. 251.

MISPICKEL. A. Schmidt. Zs. K. xii. p. 102. *Zipser Com., Cryst.*

A. Schmidt. Zs. K. xii. p. 115. *Klenocz, Cryst.*

R. Solly. Min. Mag. vi. p. 203. *Devonshire.*

MIZZONITE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

MOLYBDENITE. W. Hidden. Am. J. Sc. xxxii. p. 210. *Cryst.*

G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 67. *Oliena.*

D. Lovisato. Att. Ac. Linc. Rend. ii. p. 258. *Sardinia.*

MONAZITE. G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 149. *N. Carolina, Cryst.*

R. Scharizer. Zs. K. xii. p. 255. *Schüttenhofen;* and Verh. Geol. Reichs. 1886, p. 283.

W. Hidden. Am. J. Sc. xxxii. p. 207. *N. Carolina.*

MONT DORE. K. Oebbeke. Zs. K. xi. p. 365. *Min. of.*

MORAVICA. H. Sjögren. Jahrb. Geol. Reichs. xxxvi. p. 607. *Min. of.*

NAGYAGITE. L. Sipöcz. Zs. K. xi. p. 211. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 97.

NATROLITE. V. Goldschmidt. Ann. Mus. Wien. i. p. 130. *Spec. Grav.*
O. Luedecke. Zts. Natwiss. Halle, v. p. 390. *Clausthal.*

NEPHELINE. B. Mierisch. Min. Mitth. viii. p. 156. *Vesuvius.*

NEPHRITE? A. Törnebohm. N. J. 1886 (2), p. 191. *Sweden.*
A. Meyer. N. J. 1886 (2), p. 255. *Sweden.*

NEW MINERALS. W. Dawson. Min. Mag. vi. p. xviii. *Lead Chromate.*
K. de Kroustchoff. Bull. Soc. Min. ix. p. 85. *Spinel.*
K. de Kroustchoff. Bull. Soc. Min. ix. p. 143. *Beucha.*
A. Des Cloizeaux. Bull. Soc. Min. ix. p. 184. *Titanium Oxide.*
A. Lacroix. Bull. Soc. Min. ix. p. 51. *Peru, Oxalate.*
A. Piccini. Att. Ac. Linc. Rend. ii. (2), p. 46. *Craveggia.*
vid. Agalmatolite, Argyrodite, Arsenolamprite, Awaruite, Azorpyrrhite, Bielzite, Bruiachite, Caracolite, Cristobalite, Endlichite, Harstigite, Hydronephelite, Kobellite, Kryptolite, Lucasite, Polyarsenite, Prismatine, Ptilolite, Pyrrho-arsenite, Schungite, Spinel.

NICCOLITE. L. Sipöcz. Zs. K. xi. p. 215. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 101.

NICKEL-ORE. L. Sipöcz. Zs. K. xi. p. 214. *Chem. Dobsina;* and Ber. Chem. Ges. Berl. xix. p. 100.

NITRATINE. J. Kerr. Min. Mag. vii. p. 21.

NITRE. C. Ochsenius. Zts. Geol. Ges. xxxviii. p. 911. *Chili.*

N. CAROLINA. W. Hidden. Am. J. Sc. xxxii. p. 204. *Min. of.*

OLIVINE. B. Mierisch. Min. Mitth. viii. p. 139. *Vesuvius.*
G. v. Rath. Ber. Nied. Ges. 1886, p. 194. *Yellowstone Pk.*

ORTHITE. G. Linnemann. Ber. Ak. Wien. xciii. (2), p. 662. *Chem.*

ORTHOCLASE. A. Des Cloizeaux. Zs. K. xi. p. 605. *Elba, Cryst.*
J. Lehmann. Zs. K. xi. p. 612. *Contraction-cracks.*
A. Cathrein. Zs. K. xii. p. 35. *Mulat, Cryst.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 17. *Stainz.*
A. Purgold. Isis (Ber.), 1885, p. 34. *Königshain.*

OTTRELITE. J. Götz. N. J. Beil. Bd. iv. p. 145. *Transvaal, Chem.*
C. Klement. Min. Mitth. viii. p. 19. *Chem.*

PECTOLITE. V. Goldschmidt. Ann. Mus. Wien. i. p. 130. *Spec. Grav.*

PERAK. J. de Morgan. Ann. Min. ix. p. 368. *Min. of.*

PERCYLITE. M. Websky. Ber. Ak. Berl. 1886, p. 1045. *Chem.*

PLANERITE. A. Lacroix. Bull. Soc. Min. ix. p. 5. *Qpi.*

PLATINUM. W. Hamilton. N. Z. Inst. xviii. p, 402. *New Zealand.*

PHENACITE A. Des Cloizeaux. Am. J. Sc. xxxii. p. 210. *Cryst.;* and Bull. Soc. Min. ix. p. 171.
A. Purgold. Isis (Ber.), 1885, p. 33. *Oberwallis.*
G. Seligmann. Verh. Nat. Ver. Rheinl. xxxiv. corr. bl. p. 139. *Wallis.*

PHILLIPSITE. L. Langemann. N. J. 1886 (2), p. 110. *Mon.*

PHOLERITE. A. v. Lasaulx. Ber. Nied. Ges. Bonn. 1886, p. 10. *Neurode.*

PHOSGENITE. D. Lovisato. Att. Ac. Linc. Rend. ii. p. 254. *Sardinia.*
PHOSPHORITE. Bechevel. Ann. Min. x. p. 434. *Chem.*
PIHLITE. D. Lovisato. Att. Ac. Linc. Rend. ii. p. 259. *Sardinia.*
PISEK. E. Döll. Verh. Geol. Reichs. 1886, p. 351. *Min. of.*
POLLUX. A. Purgold. Isis (Ber.), 1885, p. 32. *Elba.*
POLYARSENITE. L. Igelström. Öfv. Vet. Ak. Förh. 1885, 7, p. 257. *New Min.*
PONTGIBAUD. F. Gonnard. Bull. Soc. Min. ix. p. 243. *Aurif. Min.*
PREDAZZO. A. Cathrein. Zs. K. xii. p. 34. *Min. of.*
PREHNITE. A. Purgold. Isis (Ber.), 1885, p. 34. *Radauthal.*
F. Schalch. N. J. Beil. Bd. iv. p. 178. *Erzgebirge.*
D. Lovisato. Att. Ac. Linc. Rend. ii. p. 258. *Sardinia.*
PRISMATINE. A. Sauer. Zts. Geol. Ges. xxxviii. p. 704. *New. Min.*
PROUSTITE. E. Rethwisch. N. J. Beil. Bd. iv. p. 31. *Mon.*
PSEUDOBROOKITE. K. Oebbeke. Zs. K. xi. p. 370. *Mt. Dore, Cryst.*
PTILOLITE. W. Cross and L. Eakins. Am. J. Sc. xxxii. p. 117. *New. Min.*
PYRARGYRITE. E. Rethwisch. N. J. Beil. Bd. iv. p. 31. *Mon.*
M. Schuster. Verh. Geol. Reichs. 1886, p. 68. *Cryst.*; and Zs. K. xii. p. 117.
PYRITES. L. Brugnatelli. Zs. K. xi. p. 363. *Cryst.*
E. Smith. Am. J. Sc. xxxi. p. 376. *Limonite pseud. after.*
J. Meem. Am. J. Sc. xxxii. p. 274. *Limonite pseud. after.*
A. Jackson. Bull. Cal. Ac. Sc. i. p. 365. *Calaveras Co., Cryst.*
R. Solly. Min. Mag. vi. p. 203. *Devonshire.*
Götting. B. H. Ztg. xlv. p. 301. *Styria, Min.*
Leuze. Jahresh. Ver. Württ. xlii. p. 63. *Quartz pseud. after.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 15, 21. *Stainz.*
H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 345. *Chem.*
E. Döll. Verh. Geol. Reichs. 1886, p. 351. *Pseud. after Tourmaline.*
A. Wendt. School Min. Q. vii. pp. 154, 218, 301. *Alleghanies.*
Nentien. Ann. Min. x. p. 462. *Chem.*
PYROLUSITE. Opperman. Ann. Min. x. p. 444. *Chem.*
PYROMORPHITE. P. Jeremejew. Verh. Russ. Min. Ges. xxii. p. 179. *Nertschinsk.*
PYROPHYLLITE. M. Websky. Zts. Geol. Ges. xxxviii. p. 473. *Georgia.*
PYROSTILPNITE. A. Streng. N. J. 1886, (1), p. 57. *Chem.*
PYRRHITE. L. Hubbard. Ber. Nied. Ges. Bonn. 1886, p. 219. *San Miguel.*
vid. Azorpyrrhite.
PYRRHO-ARSENITE. L. Igelström. Bull. Soc. Min. ix. p. 218. *New Min.*
PYRRHOTITE. H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 345. *Chem.*
G. Seligmann. Zs. K. xi. p. 343. *Cyclops Is., Cryst.*
C. Doelter. Min. Mitth. vii. p. 535. *Chem.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 16, 21. *Stainz.*

QUARTZ.
G. v. Rath. Festschr. Ver. Natk. Cassel. 1886, p. 98. *Cryst.*
G. v. Rath. Zs. K. xii. p. 453. *Cryst.*
G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 67. *Montevecchio.*
J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*
F. Gonnard. C. R. ciii. p. 1036. *Pseud. Puy-de-Dôme.*
B. V. Kolenko. Pogg. xxix. p. 416. *Pyroel.*
O. Tumlirz. Pogg. xxvii. p. 133. *Magnetic.*
V. Goldschmidt. Ann. Mus. Wien. i. p. 130. *Spec. Grav.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 11. *Stainz.*
W. Hidden and A. Des Cloizeaux. Am. J. Sc. xxxii. p. 208. *Cryst.*
J. Danker. N. J. Beil. Bd. iv. p. 266. *Opt.*
O. Tumlirz and H. Luggin. Anz. Ak. Wien. xxiii. p. 93. *Magn.*
Leuze. Jahresh. Ver. Württ. xlii. p. 62. *Pseud. after Calcite, Gypsum, Pyrites, Celestine.*
Leuze. Jahresh. Ver. Württ. xlii. p. 64. *Hyalite pseud. after.*
J. McConnel. Proc. Roy. Soc. xxxix. p. 409. *Opt.*; and Phil. Trans. clxxvii. p. 299.
W. Hidden. School Min. Q. vii. p. 334. *Pseudomorphous.*

RALSTONITE.
S. Penfield. Am. J. Sc. xxxii. p. 380. *Chem.*

REDRUTHITE.
C. John. Jahrb. Geol. Reichs. xxxvi. p. 345. *Chem.*

RHODONITE.
G. Flink. Öfv. Vet. Ak. Förh. 1885, 6, p. 159. *Pajsberg and Langban;* and Zs. K. xi. p. 506.

RITTINGERITE.
A. Streng. N. J. 1886 (1), p. 57. *Chem.*

ROSENEGG.
Leuze. Jahresh. Ver. Württ. xlii. p. 62. *Min. of.*

RUBY.
G. Kunz. Science, vii. p. 399.

RUTILE.
O. Mügge. N. J. 1886 (1), p. 147. *Twinning.*
G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 158. *N. Carolina.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 15. *Stainz.*
E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 25. *Modriach.*
M. Websky. Zts. Geol. Ges. xxxviii. p. 473. *Georgia.*

SAINT-NAZAIRE.
C. Baret. Bull. Soc. Min. ix. p. 129. *Min. of.*

SALT.
J. Lehmann. Zs. K. xi. p. 610. *Contraction-cracks.*
C. Ochsenius. N. J. 1886 (1), p. 177. *Egeln-Stassfurt.*
W. Voigt. N. J. Beil. Bd. iv. p. 228. *Elasticity.*
T. Ward. Trans. Man. Geol. Soc. xviii. p. 396. *Min.*
Leuze. Jahresh. Ver. Württ. xlii. p. 62. *Sandstone pseud. after.*
R. Williams. Chem. News, liv. p. 50. *Chem.*
M. Fack. Schr. Nat. Ver. Schles.-Hols. vi. (2), p. 47. *Schles.-Holstein.*

SAMARSKITE.
W. Crookes. Proc. Roy. Soc. xl. p. 502. *Chem.*; and C. R. cii. p. 1464; and Chem. News, liv. p. 13.

SANARKA.
A. Arzruni. Ber. Ak. Berl. 1886, p. 1211. *Min. of.*

Sanidine.	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 220. *Niedermendig.*
	B. Mierisch. Min. Mitth. viii. p. 176. *Vesuvius.*
Sarcolite.	C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*
	B. Mierisch. Min. Mitth. viii. p. 152. *Vesuvius.*
Sardinia.	D. Lovisato. Att. Ac. Linc. Rend. ii. p. 254. *Min. of.*
Scapolite, &c.	C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*
	G. Tschermak. Min. Mitth. vii. p. 400. *Chem.*
Scheelite.	E. Jannetaz and Goguel. Bull. Soc. Min. ix. p. 39. *Pyrenees.*
	T. Hiortdahl. Zs. K. xii. p. 411. *Art. Cryst.*
Schefferite.	G. Flink. Öfv. Vet. Ak. Förh. 1885, 10, p. 41. *Langban and Pajsberg;* and Zs. K. xi. p. 487.
Schungite.	A. v. Inostranzeff. N. J. 1886 (1), p. 92. *New Min.*
Scolecite.	C. Schmidt. Zs. K. xi. p. 587. *Cryst., Pyroel.*
	G. Wyrouboff. Bull. Soc. Min. ix. p. 266. *Opt.*
Scoulerite.	A. Lacroix. C. R. cii. p. 645. *Opt. Thomsonite;* and Bull. Soc. Min. ix. p. 80.
Selbeck.	Schwarze. Verh. Nat. Ver. Rheinl. xxxiv. corr. bl. p. 75. *Zinc and Lead Ores.*
Semi-opal.	R. Solly. Min. Mag. vi. p. 203. *Devonshire.*
Semseyite.	L. Sipöcz. Zs. K. xi. p. 216. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 102.
Seville.	Calderon. An. Soc. Esp. xv. p. 131. *Min.*
Silver.	G. v. Rath. Ber. Nied. Ges. 1886, p. 281. *Art.*
Silver Ores.	H. Foullon and C. John. Jahrb. Geol. Reichs. xxxvi. p. 341. *Chem.*
Smaltite.	H. Baumhauer. Zs. K. xii. p. 18. *Cryst.*
Smithsonite. (?)	J. Cooper. Bull. Washb. Lab. i. p. 170. *New Mexico.*
Sodalite.	F. Clarke. Am. J. Sc. xxxi. p. 264. *Maine, Chem.*
	B. Mierisch. Min. Mitth. viii. p. 163. *Vesuvius.*
Sphene.	E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 15, 21. *Stainz.*
	B. Mierisch. Min. Mitth. viii. p. 181. *Vesuvius.*
Spinel.	K. v. Chrustchoff. N. J. 1886 (2), p. 180. *New Variety.*
	B. Mierisch. Min. Mitth. viii. p. 182. *Vesuvius.*
Spodumene.	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 154. *N. Carolina, Cryst.*
	W. Hidden and A. Des Cloizeaux. Am. J. Sc. xxxii. p. 204. *N. Carolina.*
Staffordshire.	W. Whitaker. Rep. Brit. Ass. 1885, p. 780. *Min. Bibliography.*
Stainz.	E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 3. *Min. of.*
Stibnite.	L. Bombicci. Rendic. Ac. Bol. 1886, p. 43. *Giappone, Cryst.;* and Mem. Ac. Bol. vii. p. 129.
	Le Verrier. Ann. Min. x. p. 455. *Chem.*
Strontianite.	L. Bourgeois. C. R. ciii. p. 1089. *Art.*
Struvite.	F. Oettel. Isis (Ber.), 1885, p. 29. *Art.*
Sulphur.	V. Goldschmidt. Ann. Mus. Wien. i. p. 130. *Spec. Grav.*
	A. Schrauf. Pogg. xxvii. p. 300. *Therm. Opt.;* and Zs. K. xii. p. 321.

SULPHUR.	E. Dana. Am. J. Sc. xxxii. p. 389. *Cryst.*
	A. Purgold. Isis (Ber.), 1885, p. 31. *Perticara.*
	F. Sandberger. N. J. 1886 (1), p. 179. *Chili.*
	T. Haupt. B. H. Ztg. xlv. pp. 313, 325, 333. *Tuscany.*
	G. Lunge. Dingl. J. 259, p. 43. *Saba;* and Chem. Cent. Bl. xvii. p. 334.
	D. Gernez. Ann. Chim. Phys. vii. p. 233. *Art. Cryst.*
SYLVANITE.	L. Sipöcz. Zs. K. xi. p. 210. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 96.
SYLVITE.	R. Brauns. N. J. 1886 (1), p. 224. *Cryst.*
SZABOITE.	K. Oebbeke. Zs. K. xi. p. 373. *Mt. Dore, Cryst.*
TELLURITE.	A. Brezina. Ann. Mus. Wien. i. p. 135. *Cryst.*
TETRAHEDRITE.	G. v. Rath. Ber. Nied. Ges. 1886, p. 190. *Bolivia.*
	De Bechevel. Ann. Min. x. p. 433. *Chem.*
THENARDITE.	Leuze. Jahresh. Ver. Württ. xlii. p. 66. *Calcite pseud. after.*
THULITE.	A. Lacroix. C. R. cii. p. 645. *Opt.;* and Bull. Soc. Min. ix. p. 77.
THURINGITE.	C. Schmidt. Zs. K. xi. p. 599. *Windgällen.*
TOPAZ.	J. Lehmann. Zs. K. xi. p. 611. *Contraction-cracks.*
	W. Ramsay. Zs. K. xii. p. 216. *Refract. Index.*
	H. Bücking. Zs. K. xii. pp. 424, 451. *Mexico, Cryst.*
	F. Feist. Zs. K. xii. p. 434. *Ilmen Mts. Cryst.*
	K. Mack. Pogg. xxviii. p. 153. *Pyroel. Opt.*
	N. Nordenskiold. N. J. 1886 (1), p. 242. *Enclosures.*
	W. Cross. Am. J. Sc. xxxi. p. 432. *Nathrop.*
	A. v. Groddeck. Zts. Geol. Ges. xxxviii. p. 370. *Tasmania.*
TOURMALINE.	A. Schmidt. Zs. K. xii. p. 103. *Zipser Com. Cryst.*
	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 157. *N. Carolina.*
	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 225. *Pierrepont.*
	R. Scharizer. Verh. Geol. Reichs. 1886, p. 109. *Schütenhofen.*
	E. Döll. Ver. Geol. Reichs. 1886, p. 351. *Pyrites pseud. after.*
	J. Woldrich. Verh. Geol. Reichs. 1886, p. 454. *Bohemia.*
	A. Sauer. Zts. Geol. Ges. xxxviii. p. 705. *Waldheim.*
	W. Hidden. Am. J. Sc. xxxii. p. 205. *N. Carolina.*
	H. Schedtler. N. J. Beil. Bd. iv. p. 518. *Elect.*
	E. Riecke. Pogg. xxviii. p. 43. *Pyroel.*
	E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 12. *Stainz.*
TREMOLITE.	B. Mierisch. Min. Mitth. viii. p. 176. *Vesuvius.*
TRIDYMITE.	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 192. *Yellowstone Park.*
	G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 256. *Cryst.*
TSCHERMIGITE.	Deichmüller. Isis (Ber.), 1885, p. 33. *Dux.*
TURQUOIS.	F. Clarke and J. Diller. Am. J. Sc. xxxii. p. 211. *New Mexico.*

ULLMANNITE. F. Sandberger. N. J. 1886 (1), p. 90. *Art.*

VANADINITE. G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 34. *Arizona.*
S. Penfield. Am. J. Sc. xxxii. p. 441. *Arizona and New Mexico.*
F. Genth and G. v. Rath. Chem. News. liii. p. 218. *Lake Valley.*
J. Cooper. Bull. Washb. Lab. i. p. 169. *Arizona and New Mexico.*

VARISCITE. A. Lacroix. C. R. cii. p. 273. *Opt.;* and Bull. Soc. Min. ix. p. 5.

VESUVIUS. B. Mierisch. Min. Mitth. viii. p. 125. *Mm. of.*

WAGNERITE. A. Ditte. Ann. Chim. Phys. viii. p. 502. *Chem.*

WARWICKITE. A. Lacroix. C. R. cii. p. 644. *Opt.;* and Bull. Soc. Min. ix. p. 74.

WARWICKSHIRE. W. Whitaker. Rep. Brit. Ass. 1885, p. 780. *Min. Bibliography.*

WAVELLITE. A. Lacroix. Bull. Soc. Min. ix. p. 4. *Opt.;* and C. R. cii. p. 273.

WEHRLITE. L. Sipöcz. Zs. K. xi. p. 212. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 98.

WERNERITE. C. Rammelsberg. N. J. Beil. Bd. iv. p. 610. *Chem.*

WILLEMITE. J. Cooper. Bull. Washb. Lab. i. p. 170. *New Mexico.*

WINDGÄLLEN. C. Schmidt. Zs. K. xi. p. 597. *Min. of.*

WITHAMITE. A. Lacroix. C. R. cii. p. 644. *Opt.;* and Bull. Soc. Min. ix. p. 75. *Opt.*

WITHERITE. L. Bourgeois. C. R. ciii. p. 1089. *Art.*

WOLFRAMITE. L. Sipöcz. Zs. K. xi. p. 211. *Chem.;* and Ber. Chem. Ges. Berl. xix. p. 97.
G. Seligmann. Zs. K. xi. p. 347. *Cryst.*

WOLLASTONITE. C. Doelter. N. J. 1886 (1), p. 119. *Art.*
B. Mierisch. Min. Mitth. viii. p. 173. *Vesuvius.*
V. Goldschmidt. Ann. Mus. Wien. i. p. 130. *Spec. Grav.*

WORCESTERSHIRE. W. Whitaker. Rep. Brit. Ass. 1885, p. 780. *Min. Bibliography.*

WULFENITE. J. Cooper. Bull. Washb. Lab. i. p. 169. *Arizona.*
F. Sandberger. N. J. 1886 (1), p. 90. *S. America.*

XANTHOLITE. A. Lacroix. C. R. cii. p. 645. *Opt. Staurolite;* and Bull. Soc. Min. ix. p. 78.

XENOTIME. G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 153. *N. Carolina.*
W. Hidden and A. Des Cloizeaux. Am. J. Sc. xxxii. p. 206. *N. Carolina.*
H. Gorceix. C. R. cii. p. 1024. *Minas Geraes.*

YELLOWSTONE PARK. G. v. Rath. Ber. Nied. Ges. Bonn. 1886, p. 192. *Min. of.*

ZINC. W. Dawson. Min. Mag. vi. p. xix. *Transvaal.*

Zinc.	H. Reusch. Nyt. Mag. xxix. p. 358. *Birkeland.*
Zinc-ore.	Tingry. Ann. Min. x. p. 465. *Chem.*
	Sergère. Ann. Min. x. p. 476. *Chem.*
	Poncelet. Ann. Min. x. p. 479. *Chem.*
Zincite.	E. Dana. Am. J. Sc. xxxii. p. 388. *Cryst.;* and Zs. K. xii. p. 459.
Zircon.	A. Gehmacher. Zs. K. xii. p. 50. *Pfitsch, Cryst.*
	K. de Chrustchoff. Min. Mitth. vii. p. 423. *Microscop.*
	L. Michel. Bull. Soc. Min. ix. p. 215. *Opt. Colour.*
	L. Hubbard. Ber. Nied. Ges. Bonn. 1886, p. 218. *Laacher See.*
	E. Hussak. Mitth. Nat. Ver. Steier. xxii. p. 13. *Stainz.*
Zoisite.	E. Hussak. Mitth. Nat. Ver. Steier. xxii. pp. 13, 21. *Stainz.*

1885 *(continued).*

Allactite.	J. Krenner. Ber. Ung. iii. p. 214. *Opt.*
Amazon-stone.	E. Erdmann. Zs. K. x. p. 493. *Colour.*
Anglesite.	Q. Sella. Att. Ac. Linc. Mem. ii. p. 199. *Cryst. (republ.).*
Anorthite.	G. Struever. Att. Ac. Linc. Mem. i. p. 12. *L. Bracciano.*
Apatite.	G. Struever. Att. Ac. Linc. Mem. i. p. 13. *L. Bracciano.*
	V. v. Zepharovich. Lotos. xxxiv. p. 85. *Turquois pseud. after.*
Aragonite.	G. Dewalque. Ann. Soc. Geol. Belg. Bull. xii. p. 56. *Sarola.*
Aranyer Berg.	A. Koch. Ber. Ung. iii. p. 44. *Min. of.*
Arizona.	G. Kunz. Ann. New York Ac. iii. p. 275. *Min. of.*
Aurichalcite.	G. Kunz. Ann. New York Ac. iii. p. 278. *Arizona.*
Barytes.	F. Sansoni. Rend. Ac. Bol. 1885, p. 52. *Vernasca.*
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	G. Kunz. Ann. New York, Ac. iii. p. 278. *Arizona.*
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	G. Cesaro. Ann. Soc. Geol. Belg. Mem. xii. p. 192. *Delvauxite pseud. after.*
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	A. Firket. Ann. Soc. Geol. Belg. Bull. xii. p. 194. *Art.*
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J. Cooper. Bull. Washb. Lab. i. p. 29. *Colorado.*

OSNABRÜCK. Renesse. Jahresb. Nat. Ver. Osnabr. vi. p. 46. *Min.*

PHOSPHORITE. E. Delvaux. Ann. Soc. Geol. Belg. Buil. xii. p. 39. *Belgium*

M. Lohest. Ann. Soc. Geol. Belg. Mem. xii. p. 41. *Hesbaye.*

M. Lohest. Ann. Soc. Geol. Belg. Bull. xii. p. 74. *Alleur.*

G. Dewalque. Ann. Soc. Geol. Belg. Bull. xii. p. 93.

PROCHLORITE. G. Ulrich. N. Z. J. Sc. ii. p. 310. *N. Zealand.*

PSEUDOBROOKITE. A. Koch. Ber. Ung. iii. p. 44. *Aranyer Berg.*

PYRITES. K. Jahn. Ber. Ung. iii. p. 234. *Radna, Chem.*

Q. Sella. Att. Ac. Linc. Mem. ii. p. 213. *Cryst. (republ.).*

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G. Ulrich. N. Z. J. Sc. ii. p. 311. *N. Zealand.*

SPINEL. G. Struever. Att. Ac. Linc. Mem. i. p. 8. *L. Bracciano.*

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TOURMALINE. M. Lohest. Ann. Soc. Geol. Belg. Bull. xii. pp. 36, 95. *Belgium.*

E. Riecke. Nachr. Ges. Wiss. Gött. 1885, p. 405. *Pyroel.*

TURQUOIS. V. v. Zepharovich. Lotos. xxxiv. p. 85. *Pseud. after Apatite.*

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CRYSTALS.	B. Minnigerode. Nachr. Ges. Wiss. Gött. 1884, pp. 195, 374, 488. *Elasticity.*
	W. Voigt. Nachr. Ges. Wiss. Gött. 1884, p. 337. *Light absorption.*
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NEW MINERALS.	vid. Hanksite.

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CINNABAR.	Ponzi. Att. Ac. Linc. Trans. vii. p. 188. *Tolfa.*
SPHENE.	A. Cossa. Att. Ac. Linc. Trans. vii. p. 34. *Cont. Yttrium.*
ULLMANNITE.	C. Klein. Nachr. Ges. Wiss. Gött. 1883, p. 25. *Cryst. Chem.*

LIST OF ABBREVIATIONS USED IN INDEX.

See also Vol. vi. pp. 142, 187, 232 ; Vol. vii. p. 111.

ABH. BÖHM GES.	Abhandlungen der mathematisch-naturwissenschaftlichen Classe der k. böhmischen Gesellschaft der Wissenschaften. Prag.
ABH. NAT. GES. HALLE.	Abhandlungen der naturforschenden Gessellschaft zu Halle. Halle.
ANN. MUS. WIEN.	Annalen der k. k. naturhistorischen Hofmuseums. Wien.
ANN. SOC. BRUX.	Annales de la Société Scientifique de Bruxelles. Bruxelles.
ANN. SOC. GEOL. BELG.	Annales de la Société Géologique de Belgique (Bull. & Mem.). Liège.
ARCH. MATH. NAT.	Archiv for Mathematik og Naturvidenskab. Kristiania.
BER. NAT. GES. FREIB.	Berichte der naturforschenden Gesellschaft zu Freiburg i. Baden. Freiburg.
BULL. CAL. AC. SC.	Bulletin of the California Academy of Sciences. San Francisco.
BULL. PHIL. SOC. WASH.	Bulletin of the Philosophical Society of Washington. Washington.
BULL. SCI. NORD.	Bulletin Scientifique du Departement du Nord. Paris.
BULL. WASHB. LAB.	Bulletin of the Washburn Laboratory of Natural History. Topeka, Kansas.
DEUTSCH. NATURF.	Versammlung deutscher Naturforscher und Aerzte. (Tageblatt u. Bericht).
JAARB. AK. AMST.	Jaarboek van de Koninklijke Akademie van Wetenschappen. Amsterdam.
JAHRESB. NAT. VER. OSNABR.	Jahresbericht des naturwissenschaftlichen Vereins zu Osnabrück. Osnabrück.
KOSMOS.	Kosmos. Kopernik.
LA NAT.	La Nature. Paris.
MEM. AC. TOUL.	Mémoires de l'Académie des Sciences, Inscriptions, et Belles-Lettres de Toulouse. Toulouse.
NACHR. GES. WISS. GÖTT.	Nachrichten von der k. Gesellschaft der Wissenschaften und der Georg-Augusts-Universitäts zu Göttingen. Göttingen.
N. Z. J. SC.	The New Zealand Journal of Science. Dunedin.
PUBL. INST. LUX.	Publications de l'Institut Royal Grand Ducal de Luxembourg. Luxembourg.
SCI. GOSS.	Hardwicke's Science Gossip. London.
SCHOOL MIN. Q.	The School of Mines Quarterly. New York.
VERH. SIEB. VER.	Verhandlungen und Mittheilungen des Siebenbürgischen Vereins für Naturwissenschaften. Hermannstadt.

EXCERPT MINUTES OF COUNCIL MEETING

Held at the Museum, Jermyn Street, Oct. 25th, 1887.

The Draft Report of Council for the past Session was adopted.

The following days were fixed for the Meetings in the Session 1887-8.

January 10th, 1888.
May 8th.
October 30th, Anniversary.

It was resolved, "That in addition to three Meetings to be held in England, a Meeting be held in Scotland, provided a sufficient number of Members signify their intention of being present."

ANNIVERSARY MEETING.

Held at the Museum, Jermyn Street, Oct. 25th, 1887.

L. Fletcher, M.A., F.G.S., President, in the Chair.

The following Report of Council was read and adopted:—

REPORT.

The Balance Sheet, which appeared in No. 34 of the Journal, showed a healthy condition of the Society, as to its finances. The excess of Assets over Liabilities was, at the commencement of the year, £265 5s. 5d., being an increase of £24 1s. 2d. during the twelve months. The net expenditure on the Journal was £74 12s. 3d., as compared with £71 8s. 5d. in 1885.

The elections to the Society during the year have been five. The Council have to regret the loss by death of Dr. H. Furuhjelm, Inspector of Mines for Finland, of whom an obituary notice by Dr. H. Gylling will appear in the next number of the Journal. The resignations during the year have been seven, while the names of three gentlemen have been removed in accordance with Rule XXX. (for non-payment of subscriptions).

Two meetings have been held since the last anniversary—on January 11th and May 10th, 1887 respectively: they were held as usual in the Museum of Economic Geology, by kind permission of the Director-General of the Geological Survey.

Two numbers of the Journal have appeared during the year; No. 33 contained a most interesting paper by Prof. Judd, F.R.S., on the theory of Schillerization, while the chief feature of the last part has been the account, by our President, of the Youndegin Meteorite from West Australia, in which he has been fortunate enough to re-discover the cubic crystals of graphitic carbon, which had been announced by Haidinger, in 1846, as present in the Arva Meteorite, and were regarded by him as of pseudomorphous origin.

The following were elected Officers and Council for the ensuing year :—

President.	L. Fletcher, M A., F.G.S.
Vice-Presidents.	Rev. S. Haughton, M.D., F.R.S.
	W. H. Hudleston, J.P., M.A., F.R.S.
Council.	A. Geikie, LL.D., F.R.S.
	Rev. H. Gurney, M.A.
	Hugo Müller, Ph.D., F.R.S.
	Rev. W. W. Peyton.
	Prof. J. W. Judd, F.R.S.
	Prof. E. Kinch, F.C.S.
	Prof. W. Ivison Macadam, F.C.S.
	J. J. H. Teall, M.A., F.G.S.
	Prof. A. H. Church, M.A., F.C.S.
	Townshend M. Hall, F.G.S.
	Col. C. A. McMahon, F.G.S.
	J. Stuart Thomson.
Treasurer.	Rev. Prof. T. G. Bonney, M.A., D.Sc., F.R S.
General Secretary.	R. H. Scott, M.A., F.R.S.
Foreign Secretary.	T. Davies, F.G.S.
Auditors.	B. Kitto, F.G.S.
	F. W. Rudler, F.G.S.

The thanks of the Society were voted to the retiring Members, Messrs. Danby, Dobbie, Prof. Lewis, and Dr. Burghardt.

The following papers were read :—

"On a Meteoric Iron, containing crystallised Chromite, found in Greenbrier County, West Virginia, about the Year 1880." By the President. (p. 183.)

"On the Nature and Origin of Clays." By J. H. Collins, F.G.S. (p. 205.)

"Note on the occurrence of what may prove to be a new Mineral Resin." By J. Stuart Thomson. (p. 215.)

"On a variety of Glaucophane from the Val Chisone (Cottian Alps)." By Rev. Prof. T. G. Bonney, F.R.S. (p. 191.)

"On the discovery of Leucite in Australia." By Prof. J. W. Judd, F.R.S. (p. 194.)

"On Proustite containing Antimony." By H. A. Miers, M.A., and G. T. Prior, B.A. (p. 196.)

"Description of a new Student's Goniometer." By H. A. Miers, M.A.

"On the occurrence of Rutile Needles in Clays." By J. J. H. Teall, F.G.S. (p. 201.)

The following specimens were exhibited :—

Cubic Crystals of Graphitic Carbon from the Meteoric Iron of Youndegin.

Crystals of Chromite from the Meteoric Iron of Greenbrier County.

Opal from Queensland.

Large Cubic Crystal of Fluor from Switzerland.

Vol. VII

ERRATA.

Page 146, line 3, *read* ZX *for* ZH.

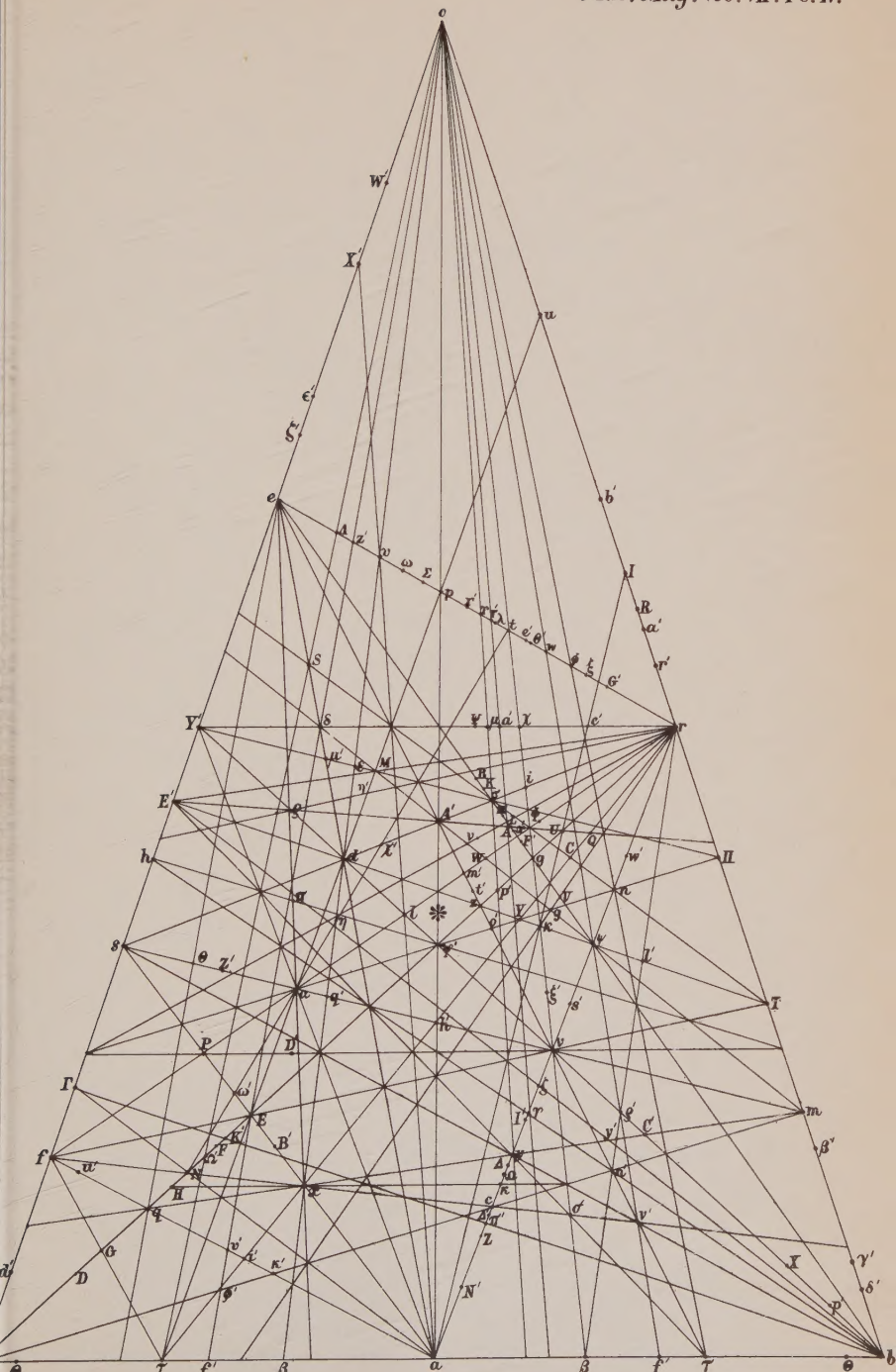
In the Table, on p. 149—

Column (1) *read* $a \quad 10\bar{1}$ *for* $a \quad 101$.
,, (2) ,, $v' \quad 11\,\bar{1}\,\bar{7}$,, $v' \quad 51\bar{3}$.
,, (3) ,, $S \quad 86\bar{7}$,, $S \quad 431$.
,, (4) ,, $B' \quad 73\bar{7}$,, $B' \quad 737$.
,, (7) the last six symbols should be raised through one line.
,, (8) insert $\Sigma' \; 52\bar{2}$.

In Plate IV. the point v' should be at the intersection of the lines joining $n'v$ and $n'c$; and Π' should be inserted between $p\Gamma'$ on the line joining uX'. Insert Σ' at the intersection of the lines joining rd and lv. S should be between $\theta z'$ on a line joining hx.

Page 77, line 2, *ab infra*, for "Gerner" *read* "Gesner."

This NUMBER completes VOLUME VII. The TITLE-PAGE and INDEX will appear in NUMBER 36.



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ORIGINALLY PRINTED IN GREAT BRITAIN BY MESSRS. WILLIAMS AND STRAHAM, LONDON. REPRINTED OFFSET LITHO BY BIDDLES LTD., THE CITY PRESS, GUILDFORD, SURREY